9-4940-468-14

TM 9-4940-468-14

TECHNICAL MANUAL

OPERATOR'S, ORGANIZATIONAL, DIRECT SUPPORT
AND
GENERAL SUPPORT MAINTENANCE MANUAL

FOR

TOOL OUTFIT, HYDRAULIC SYSTEMS TEST AND REPAIR (HSTRU) (NSN 4940-01-036-5784)

HEADQUARTERS, DEPARTMENT OF THE ARMY
AUGUST 1980

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WARNING

FIRE OR ELECTRICAL SHOCK

may occur if this equipment is not properly grounded prior to applying electrical power.

PERSONAL INJURY

may occur if this equipment is not properly prepared prior to use. (See PMCS Items 1 through 18).

ROTATING MACHINERY

is installed in this equipment. Personnel injury may occur if proper safety techniques are not used.

FLUIDS UNDER PRESSURE UP TO 10,000 PSI

are used with this equipment. Injury may result if personnel fail to observe safety precautions.

PERSONAL INJURY

may occur if proper lifting and bending techniques are not used.

DANGEROUS CHEMICAL SOLVENTS

are used with this equipment. Injury may result if personnel fail to observe safety precautions.

KEEP WORK AREA CLEAN

cluttered areas and benches invite accidents.

KEEP VISITORS AWAY

all visitors should be kept a safe distance from the work area.

USE THE RIGHT TOOL

do not try to force a tool to do a job that it was not designed to do.

WARNING

WEAR PROPER APPAREL

do not wear loose clothing or jewelry. These items may get caught in moving parts.

WEAR EYE PROTECTORS

wear safety glasses or goggles while operating power tools and wash rack. Also face or dust mask if operation creates dust. All persons in the area where power tools are being operated should also wear safety eye protectors.

DO NOT ABUSE POWER CORDS

never carry power tools by their cords. Do not yank cords to disconnect them from receptacles.

SECURE YOUR WORK

use clamps or vise to hold work. This is safer than using your hand and it frees both hands for tool operation.

MAINTAIN TOOLS WITH CARE

keep tools sharp and clean for best and safe operation. Follow instructions for lubricating and changing accessories. Replace worn, broken or lost parts immediately.

DISCONNECT TOOLS

when not in use, when servicing, and when changing accessories.

AVOID ACCIDENTAL STARTING

do not carry plugged in tools with your finger on the switch. Be sure switches are off before plugging in tools.

LIST OF EFFECTIVE PAGES

INSERT LATEST CHANGED PAGES. DESTROY SUPERSEDED PAGES.

NOTE: The portion of the text affected by the changes is indicated by a vertical line in the outer margins of the page. Changes to illustrations are indicated by miniature pointing hands. Changes to wiring diagrams are indicated by shaded areas.

TOTAL NUMBER OF PAGES IN THIS PUBLICATION IS 282 CONSISTING OF THE FOLLOWING:

Page No.	*Change No.
Title	0
A	0
a-b	0
i-vii	0
1-0 - 1-44	0
2-1 - 2-140	0
3-1 - 3-23	0
3-24 Blank	0
4-1 - 4-24	0
A-1 - A-2	0
B-1 - B-8	0
C-1 - C-8	0
D-1 - D-8	0
E-1 - E-2	0
INDEX-1 - INDEX-6	0

*Zero in this column indicates an original page.

Technical Manual
No. 9-4940-468-14

HEADQUARTERS
DEPARTMENT OF THE ARMY
Washington, DC, 29 August 1980

OPERATOR'S, ORGANIZATIONAL, DIRECT SUPPORT AND GENERAL SUPPORT MAINTENANCE MANUAL

TOOL OUTFIT, HYDRAULIC SYSTEMS TEST AND REPAIR (HSTRU)

(NSN 4940-01-036-5784)

REPORTING OF ERRORS

You can help improve this manual. If you find any mistakes or if you know of a way to improve the procedures, please let us know. Mail your letter, DA Form 2028 (Recommended Changes to Publications and Blank Forms), or DA Form 2028-2 located in back of this manual direct to: Commander, Headquarters, US Army Armament Materiel Readiness Command, ATTN: DRSAR-MAS-T Rock Island, IL 61299. A reply will be furnished to you.

Table of Contents

		Paragraph	Page
CHAPTER 1.	*INTRODUCTION*		1-1
Section I.	General Information		1-1
	Scope	1-1	1-1
	Maintenance Forms and Records	1-2	1-1
	Reporting Equipment Improvement Recommendations (EIR's)	1-3	1-1
	List of Abbreviations	1-4	1-1
Section II.	Equipment Description		1-4
	Equipment Purpose, Capabilities, and Features	1-5	1-4
	Location and Description of Major Components of the HSTRU	1-6	1-4
	Performance Data	1-7	1-4
Section III.	Technical Principles of Operation		1-18
	General	1-8	1-18
	Tools	1-9	1-18
	Functions	1-10	1-18
	Electrical Power Connection	1-11	1-35
	Equipment Storage Arrangement	1-12	1-35
	Miscellaneous Tools and Supplies	1-13	1-35

Table of Contents (Continued)

		Paragraph	Page
	O-Ring Kit	1-14	1-35
	O-Ring Fabrication Kit	1-15	1-35
	Work Areas	1-16	1-35
	Power Requirements	1-17	1-35
CHAPTER 2.	*INSTALLATION AND OPERATING INSTRUCTIONS*		2-1
Section I.	Service Upon Receipt		2-1
	General	2-1	2-1
	Inspection	2-2	2-1
Section II.	Description and Use of Operators Controls and Indicators		2-1
	General	2-3	2-1
Section III.	Preventive Maintenance Checks and Services		2-14
	General	2-4	2-14
Section IV.	Operation Under Usual Conditions		2-63
	General	2-5	2-63
	Preparation for Use.	2-6	2-63
	Initial Adjustment, Daily Checks and Self Test	2-7	2-64
	Operating Procedure	2-8	2-64
	Operation of Auxiliary Equipment	2-9	2-64
	Hose Coupling Application	2-10	2-64
	Tube Assembly Fabrication	2-11	2-75
	Multi-Range Pressure Gage	2-12	2-93
	Hydraulic System Tester	2-13	2-94
	Transfer Pump	2-14	2-101
	Flushing Filter	2-15	2-102
	Proof Pressure Tester	2-16	2-103
	Tachometer	2-17	2-103
	Impact Wrench	2-18	2-104
	Solvent Wash Unit	2-19	2-107
	O-Ring Fabrication Kit	2-20	2-107
	Troubleshooting Adapter Kit	2-21	2-110
	Preparation for Movement	2-22	2-134
Section V.	Operation Under Unusual Conditions		2-138
	General	2-23	2-138
	Operation in Unusual Weather	2-24	2-138
	Extreme Moist Heat	2-25	2-138
	Extreme Dry Heat	2-26	2-138
	Extreme Cold	2-27	2-139
	Salt Air and Sea Spray	2-28	2-139
	Duststorms and Sandstorms	2-29	2-139
	High Altitudes	2-30	2-139
	Snow or Mud	2-31	2-139
	Fording	2-32	2-139
	Emergency Procedures	2-33	2-140
	Hose Cutting	2-34	2-140
	Hose Coupling Assembly	2-35	2-140

Table of Contents (Continued)

		Paragraph	Page
	Tube Preparation	2-36	2-140
	ols Requiring Electrical Power	2-37	2-140
CHAPTER 3.	*OPERATORS AND ORGANIZATIONAL MAINTENANCE INSTRUCTIONS*		3-1
Section I.	Repair Parts, Special Tools, and Equipment		3-1
	Special Tools and Equipment	3-1	3-1
	Repair Parts	3-2	3-1
Section II.	Lubrication Order		3-1
	General Lubrication Information	3-3	3-1
Section III.	Troubleshooting		3-7
	Introduction	3-4	3-7
	Troubleshooting Table	3-5	3-7
Section IV.	Maintenance Instructions		3-12
	General	3-6	3-12
	HSTRU Body	3-7	3-12
	Electrical Distribution System	3-8	3-13
	Solvent Cleaning System	3-9	3-15
	Electrical Tools	3-10	3-17
	Tube Flaring Tool	3-11	3-18
	Servicing Hand Tools	3-12	3-19
	Cleaning	3-13	3-22
	Accessory Maintenance	3-14	3-22
	Test Equipment	3-15	3-22
CHAPTER 4.	*DIRECT SUPPORT AND GENERAL SUPPORT MAINTENANCE*		4-1
Section I.	Direct Support Maintenance		4-1
	General	4-1	4-1
	Troubleshooting	4-2	4-1
	Repair Parts, Special Tools and Equipment	4-3	4-1
	HSTRU Body	4-4	4-1
	Electrical Distribution System	4-5	4-6
	Solvent Tank	4-6	4-9
	Solvent Wash Pump	4-7	4-9
	Solvent Cleaning Tray	4-8	4-9
	Electrical Tools	4-9	4-10
	Tube Flaring Tool	4-10	4-17
	Machinists' Vise	4-11	4-19
	Hand Pump	4-12	4-19
	Pressure Gage	4-13	4-21
Section II.	General Support Maintenance		4-22
	General	4-14	4-22
	Circuit Breaker Box	4-15	4-22
	Multi-Range Pressure Gage	4-16	4-23
	Proof Pressure System Pressure Gage	4-17	4-24
	Hydraulic System Tester	4-18	4-24

Table of Contents (Continued)

	Paragraph	Page
APPENDIX A. REFERENCES		A-1
APPENDIX B. MAINTENANCE ALLOCATION CHART		B-1
APPENDIX C. EXPENDABLE SUPPLIES AND MATERIALS LIST		C-1
APPENDIX D. TOOL BOX PACKING		D-1
APPENDIX E. TOOL BOX LOADING DIAGRAM		E-1
INDEX		INDEX-1

LIST OF ILLUSTRATIONS

Figure	Title	Page
1-1	Tool Outfit, Hydraulic Systems Test and Repair, Curb Front Side	1-0
1-2	Tool Outfit, Hydraulic Systems Test and Repair, Curb Rear Side	1-2
1-3	Tool Outfit, Hydraulic Systems Test and Repair, Street Rear Side	1-2
1-4	HSTRU Data Plates, Curb Front	1-5
1-5	HSTRU Data Plates, Curb Rear	1-6
1-6	HSTRU Data Plates, Street Rear	1-7
1-7	HSTRU Data Plates, Street Front	1-8
1-8	HSTRU Data Plates, Curb Side, Doors Open	1-9
1-9	HSTRU Data Plates, Curb Side, Doors Open	1-10
1-10	HSTRU Data Plates, Street Rear, Doors Open	1-11
1-11	Location and Description of HSTRU Components	1-12, 1-14
1-12	Hose Cutting Saw	1-19
1-13	Hose Skiving Tool	1-20
1-14	Hose Coupling Assembler	1-20
1-15	Crosscut Vise	1-23
1-16	Deburring Tool	1-23
1-17	Tube Bender	1-24
1-18	Tube Flaring Tool	1-25
1-19	Multi-Range Pressure Gage	1-26
1-20	Hydraulic Systems Tester	1-27
1-21	Hydraulic Systems Flushing Filter (Assembly)	1-28, 1-29
1-22	Filter Bypass Indicator, Reading Normal	1-30
1-23	Filter Bypass Indicator, Reading Bypassed	1-30
1-24	Transfer Pump	1-31
1-25	Hand Pump	1-32
1-26	Wash Rack	1-33
1-27	Adapter Fitting Kit	1-34
1-28	Ground Stakes Storage Compartment	1-36
1-29	Slide Mounted Tool	1-37
1-30	Tool Box Storage	1-38
1-31	Hose Storage	1-39
1-32	Tubing Storage	1-40
1-33	Drop Light	1-41
1-34	Tachometer	1-42
1-35	O-Ring Kit and O-Ring Fabrication Kit	1-43
1-36	Work Areas	1-44
2-1	Hand Pump Flow Control Valve, Handle, and Pressure Gage	2-3
2-2	Hose Cutter Power Switch and Blade Lock Pin	2-4
2-3	Transfer Pump Control and Indicator	2-5
2-4	Tube Bender Controls and Indicator	2-6
2-5	Hose Coupling Assembler Controls	2-7
2-6	Tube Flaring Tool Tube Stop Knob	2-8
2-7	Circuit Breaker and Visual Trip Indicator. (RED)	2-9
2-8	Tachometer	2-10
2-9	Hydraulic System Tester	2-11
2-10	Multi-Range Pressure Gage	2-12
2-11	Electrical Circuit Hook-up Indicator	2-13
2-12	Flaring Examples	2-89
2-13	Analysis of a Typical Equipment Hydraulic Circuit	2-96

LIST OF ILLUSTRATIONS (Continued)

Figure	Title	Page
2-14	Connecting a Pipe Thread Port to a TEE	2-115
2-15	Connecting an O-Ring Boss Port to a TEE	2-116
2-16	Connecting a 37 Degree Flare Line to the TEE	2-117
2-17	Connecting a Flareless Line to the TEE	2-118
2-18	Connecting a 4-Bolt Split Flange Port to a TEE	2-119
2-19	Connecting a 4-Bolt Split Flange Face to a TEE	2-120
2-20	Connecting the Hydraulic System Tester to a TEE	2-121
2-21	Connecting the Multigage to the TEE	2-122
2-22	Connecting a 37 Degree Flare Hose or Tube Assembly to the Proof Pressure Tester	2-123
2-23	Adapting 1-1/4 Inch 37° Flare Hose or Tube Assembly to the Proof Pressure Tester	2-124
2-24	Adapting a 1-1/2 Inch 37° Flare Hose or Tube Assembly to the Proof Pressure Tester	2-125
2-25	Adapting a 4-Bolt Split Flange Hose Assembly to the Proof Pressure Tester	2-127
2-26	Adapting a Flareless Tube or Hose Assembly to the Proof Pressure Tester	2-128
2-27	Adaption of the Flushing Filter to the Return Line	2-130
2-28	Tube Fitting Kit No. 2	2-131, 2-132, 2-133
3-1	Lubrication Order	3-2, 3-3, 3-4, 3-5, 3-6
3-2	Electrical System Schematic	3-14

LIST OF TABLES

Number	Title	Page
1-1.	List of Abbreviations, Acronyms, and Symbols	1-3
1-2.	HSTRU Performance Data	1-16, 1-17
2-1.	Index of Controls and Indicators	2-2
2-2.	Hose Size and Type with Maximum Working Pressure	2-65
2-3.	Recommended Flaring Pressures	2-87, 2-88
2-4.	Connecting a Pipe Thread Port to a "TEE"	2-115
2-5.	Connecting an O-Ring Boss Port to a "TEE"	2-116
2-6.	Connecting a 37 Degree Flare Line to the "TEE"	2-117
2-7.	Connecting a Flareless Line to the "TEE"	2-118
2-8.	Connecting a 4-Bolt Split Flange Port to a "TEE"	2-119
2-9.	Connecting a 4-Bolt Split Flange Face To a "TEE"	2-120
2-10.	Connecting the Hydraulic System Tester to a "TEE"	2-121
2-11.	Connecting the Multigage to the "TEE"	2-122
2-12.	Connecting a 37 Degree Flare Hose or Tube Assembly to the Proof Pressure Tester	2-123
2-13.	Connecting a 4-Bolt Split Flange Hose Assembly to the Proof Pressure Tester	2-126
2-14.	Adapting a Flareless Tube or Hose Assembly to the Proof Pressure Tester	2-128, 2-129
2-15.	Adaption of the Flushing Filter to the Return Line	2-129

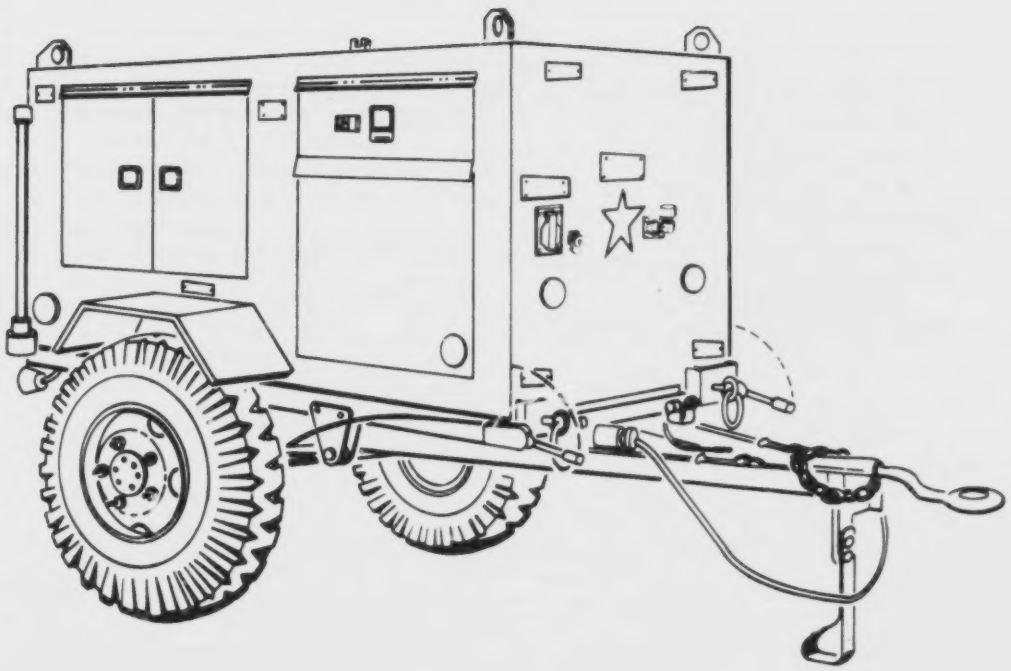


Figure 1-1. Tool Outfit, Hydraulic Systems Test and Repair, Curb Front Side.

CHAPTER 1

INTRODUCTION

SECTION I

GENERAL INFORMATION

1-1. Scope. The purpose of this manual is to familiarize you with the Tool Outfit, Hydraulic Systems Test and Repair (HSTRU). This manual covers the organizational, direct and general support maintenance instructions and operating procedures for the HSTRU. The manual will also cover the use and maintenance of the tools and equipment included in the HSTRU. Figures 1-1, 1-2, and 1-3 show general views of the HSTRU. For maintenance of the trailer chassis refer to TM9-2330-202-14&P, Trailer, Cargo, 3/4 Ton, 2-wheel, M116A1.

Purpose of Equipment. The HSTRU has been designed to be a simple-to-operate test and repair unit. It is a unit which can be used with many types of equipment which have hydraulic (fluid power) systems.

1-2. Maintenance Forms and Records. Department of the Army forms and procedures used for equipment maintenance will be those prescribed by TM 38-750, The Army Maintenance Management Systems (TAMMS).

1-3. Reporting Equipment Improvement Recommendations (EIR's). EIR's can and must be submitted by anyone who is aware of an unsatisfactory condition with the equipment design or use. It is not necessary to show a new design or list a better way to perform a procedure, just simply tell why the design is unfavorable or why a procedure is difficult. EIR's may be submitted on Standard Form 368. Mail directly to U.S. Army Armament Material Readiness Command, Attn: DRSAR-MAO, Rock Island Arsenal, Rock Island, Illinois 61299. A reply will be furnished to you.

1-4. List of Abbreviations. Table 1-1 lists abbreviations, acronyms, and symbols used in this manual and tells their meanings.

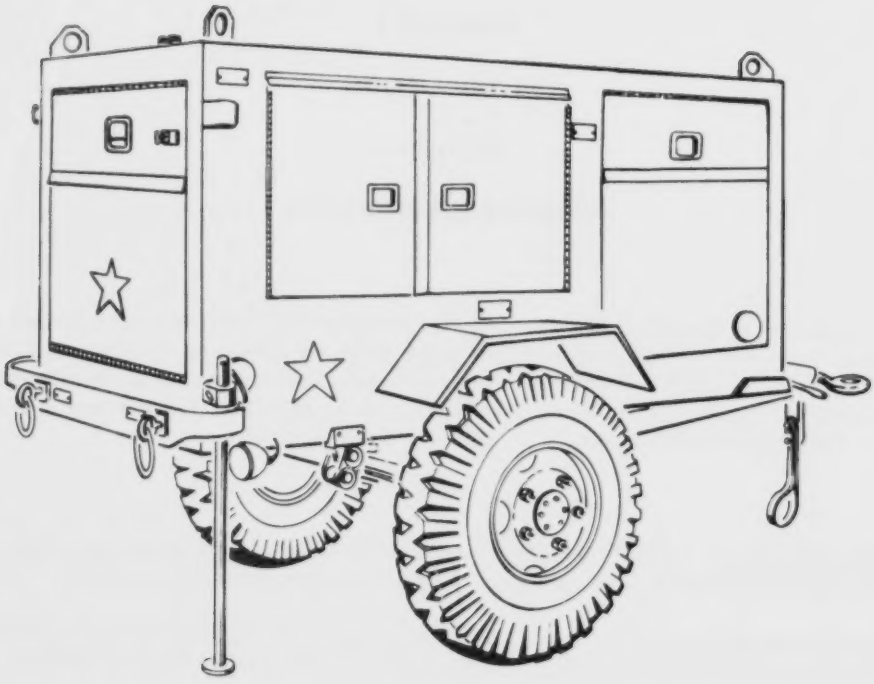


Figure 1-2. Tool Outfit, Hydraulic Systems Test and Repair. Curb Rear Side.

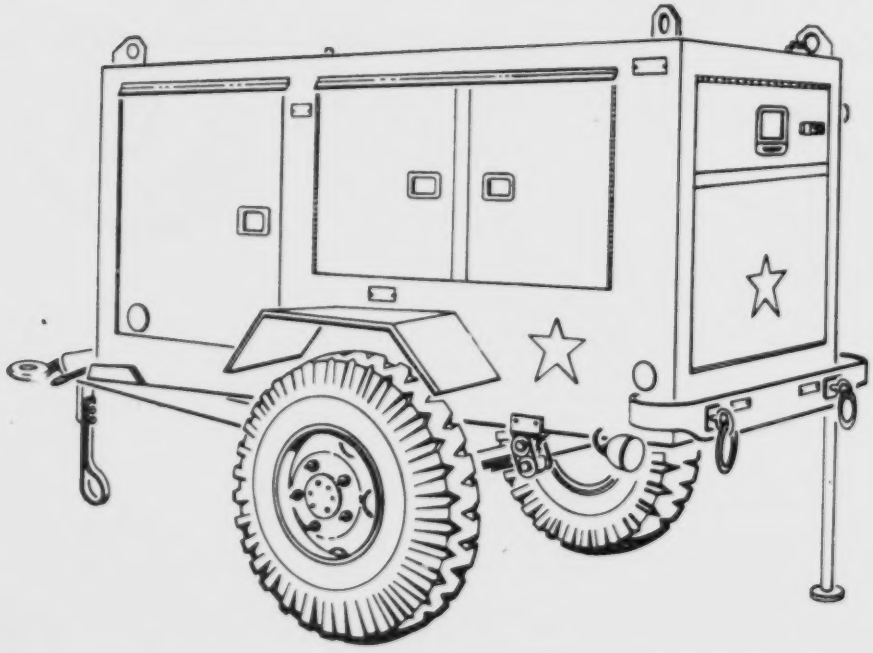


Figure 1-3. Tool Outfit, Hydraulic Systems Test and Repair. Street Rear Side.

Table 1-1. List of Abbreviations, Acronyms, and Symbols.

ABBREVIATION	NAME
AC	Alternating Current
AMP	Amperes
Hz	cycles per second
DC	Direct Current
EIR	Equipment Improvement Recommendation
EQPT	Equipment
FOD	Foreign Object Damage
GFE	Government Furnished Equipment
GPH	Gallons Per Hour
GPM	Gallons Per Minute
HP	Horsepower
HSTRU	Tool Outfit, Hydraulic Systems Test and Repair
IAW	In Accordance With
ID	Inside Diameter
in	inch(es)
lb	pound(s)
MPH	Miles Per Hour
NPT	National Pipe Thread
OD	Outside Diameter
PMCS	Preventive Maintenance Checks and Services
PSI	Pounds per Square Inch
RPM	Revolutions Per Minute
SAE	Society of Automotive Engineers
TAMMS	The Army Maintenance Management System
VAC	Volts, AC (Alternating Current)
OE	Lubricating Oil, Internal Combustion Engine, 10 Weight
HDO	Lubricating Oil, Internal Combustion Engine, Heavy Duty, 50 Weight
LSA	Lubricant, Semi-Fluid, Automatic Weapon
GAA	Grease, Artillery and Automotive
OEA	Oil, Engine, Arctic

SECTION II

EQUIPMENT DESCRIPTION

1-5. Equipment Purpose, Capabilities, and Features.

a. General. The Tool Outfit, Hydraulic Systems Test and Repair is fully mobile. It contains the tools and test equipment normally required to test and repair hydraulic systems in the field. It has been designed as a test and repair unit which can be used with many types of hydraulic systems. It has the capability of supporting a wide range of hydraulic systems. It is operated by electrical power (60 Hz, 120 volt). The HSTRU includes hand tools so that many operations may be performed when no electrical power is available.

Among the things which can be done with the HSTRU are:

(1) Fabricating hose assemblies

(2) Fabricating tube assemblies

(3) Fabricating and replacing O-ring seals

(4) Pressure Measurement

(5) Static Proof pressure testing of hydraulic components

(6) Fault Isolation of hydraulic system failures (Locate faulty components)

(7) Flushing and cleanup of hydraulic systems

(8) Tranferring hydraulic fluid to and from reservoirs and storage containers

(9) Washing system components with solvent

(10) Attaching test instruments with troubleshooting adapter kit

b. Mobility and Transportability. The HSTRU is capable of being towed cross country up to 30 MPH. It can also be moved by aircraft, helicopter, and railroad. A number of power tools are included to make maintenance and repair easier. Most power tools are backed up by hand tools in case of a loss of electrical power. Figures 1-4 through 1-10 show general views of the HSTRU and the location and content of data plates.

1-6. Location and Description of major components of the HSTRU. Figure 1-11 shows the location and description of major components.

1-7. Performance Data. Table 1-2 gives the performance for the HSTRU.

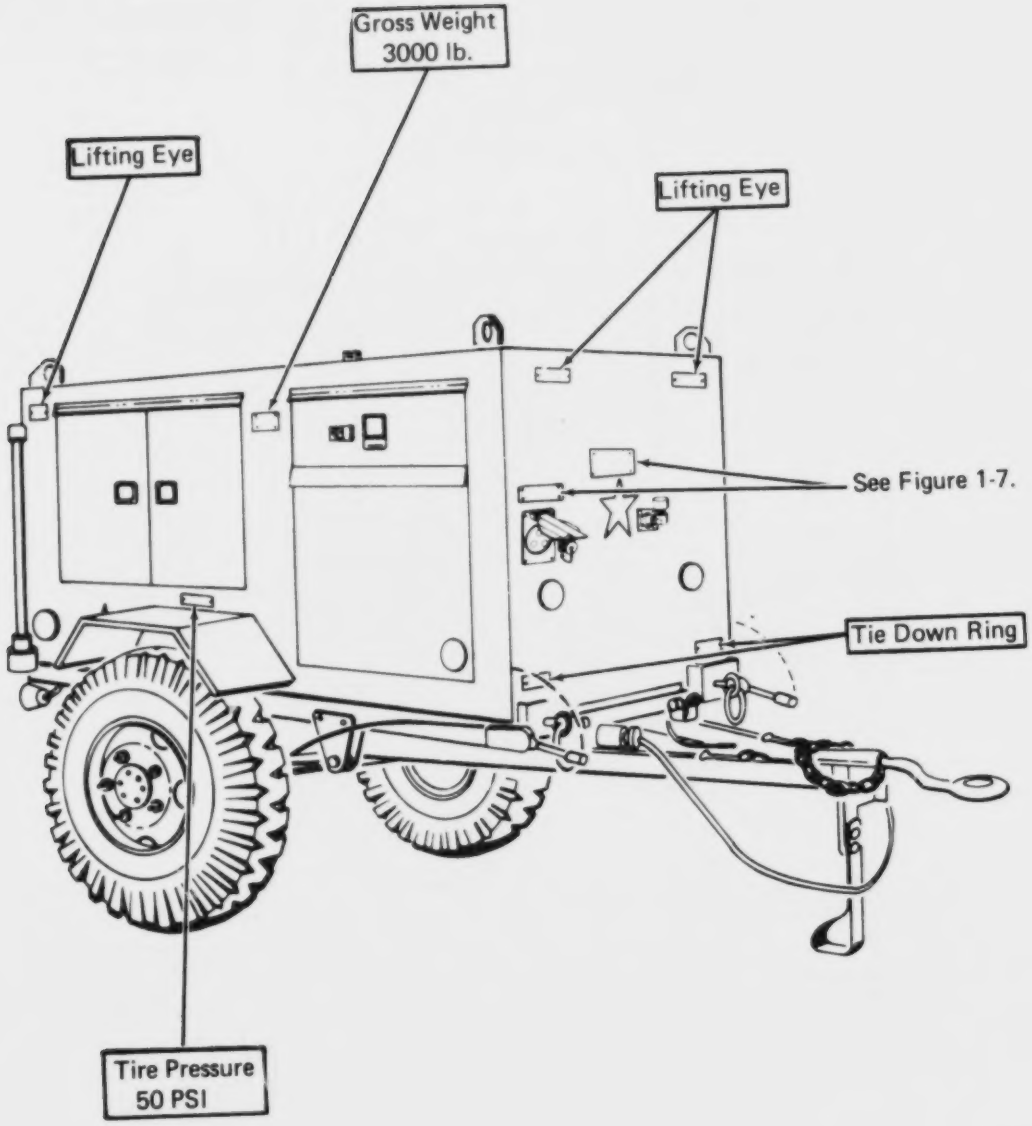


Figure 1-4. HSTRU Data Plates, Curb Front.

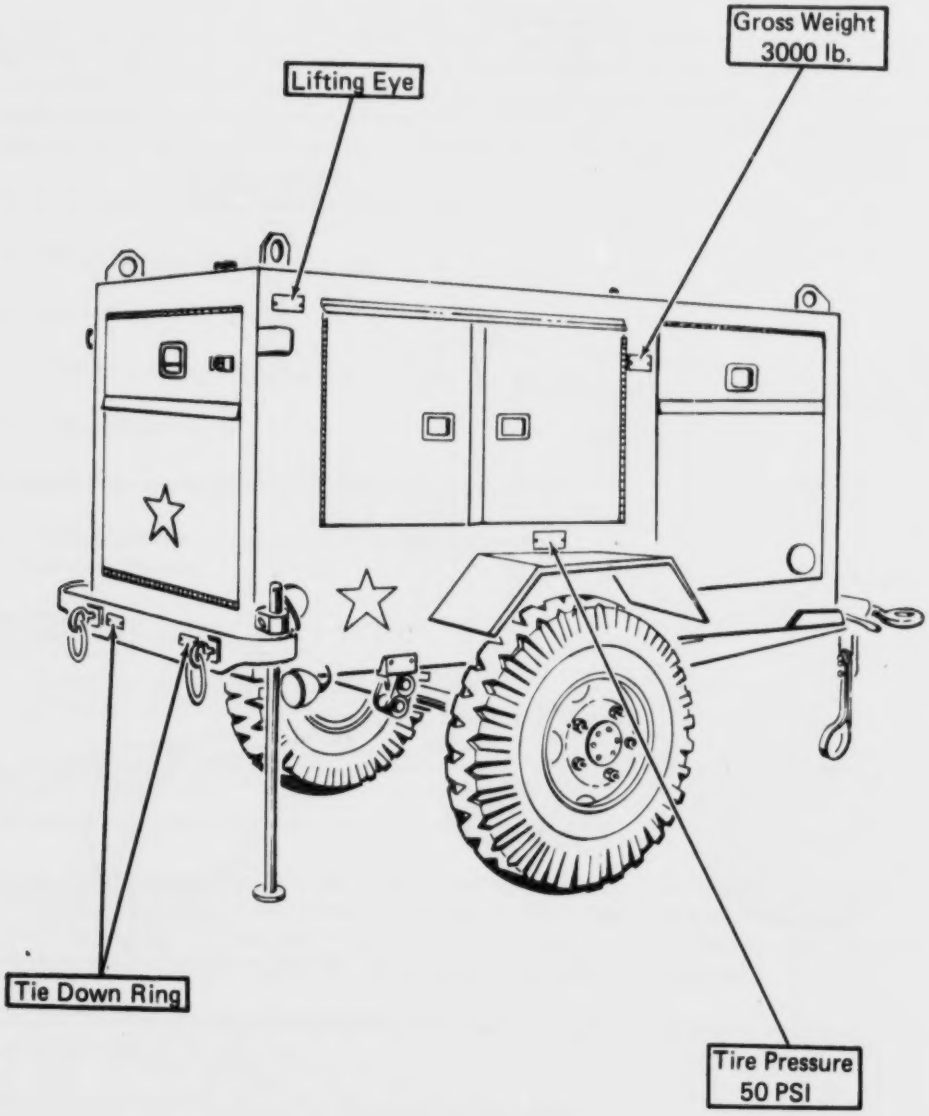


Figure 1-5. HSTRU Data Plates, Curb Rear.

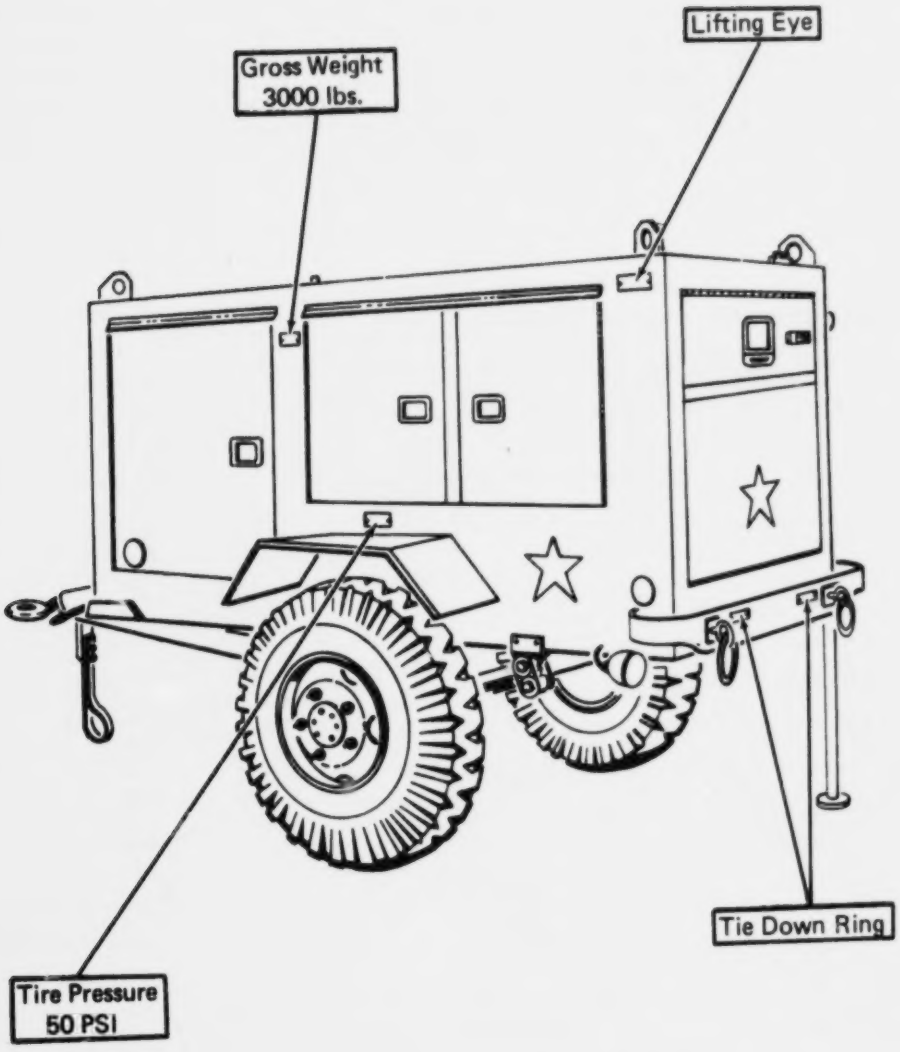


Figure 1-6. HSTRU Data Plates, Street Rear.

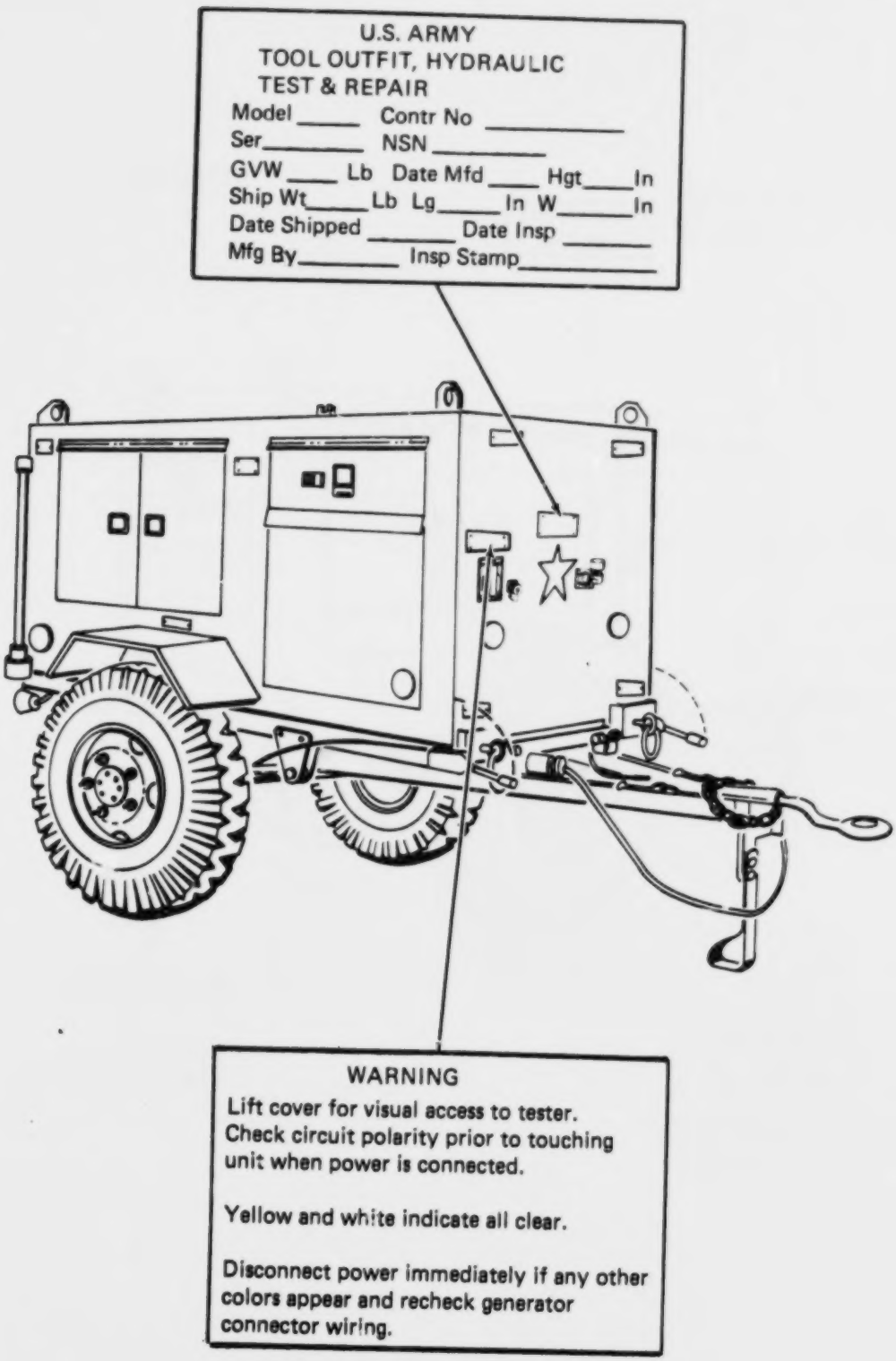

U.S. ARMY
TOOL OUTFIT, HYDRAULIC
TEST & REPAIR
Model _____ Contr No _____
Ser_____ NSN _____
GVW ____ Lb Date Mfd ____ Hgt____In
Ship Wt_____Lb Lg_____In W_____In
Date Shipped _____ Date Insp _____
Mfg By_____ Insp Stamp_____
WARNING
Lift cover for visual access to tester.
Check circuit polarity prior to touching unit when power is connected.
Yellow and white indicate all clear.
Disconnect power immediately if any other colors appear and recheck generator connector wiring.

Figure 1-7. HSTRU Data Plates, Street Front.

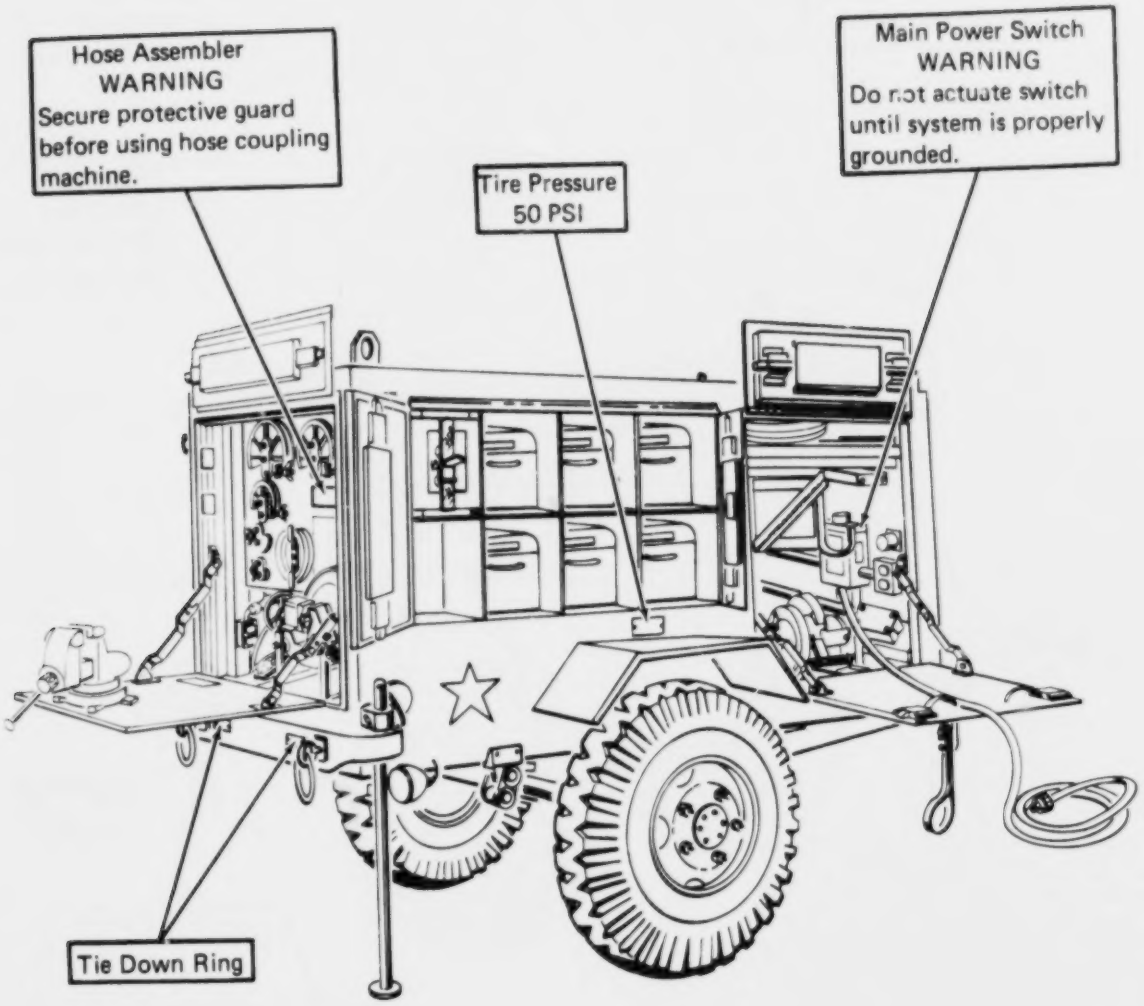


Figure 1-8. HSTRU Data Plates, Curb Side, Doors Open

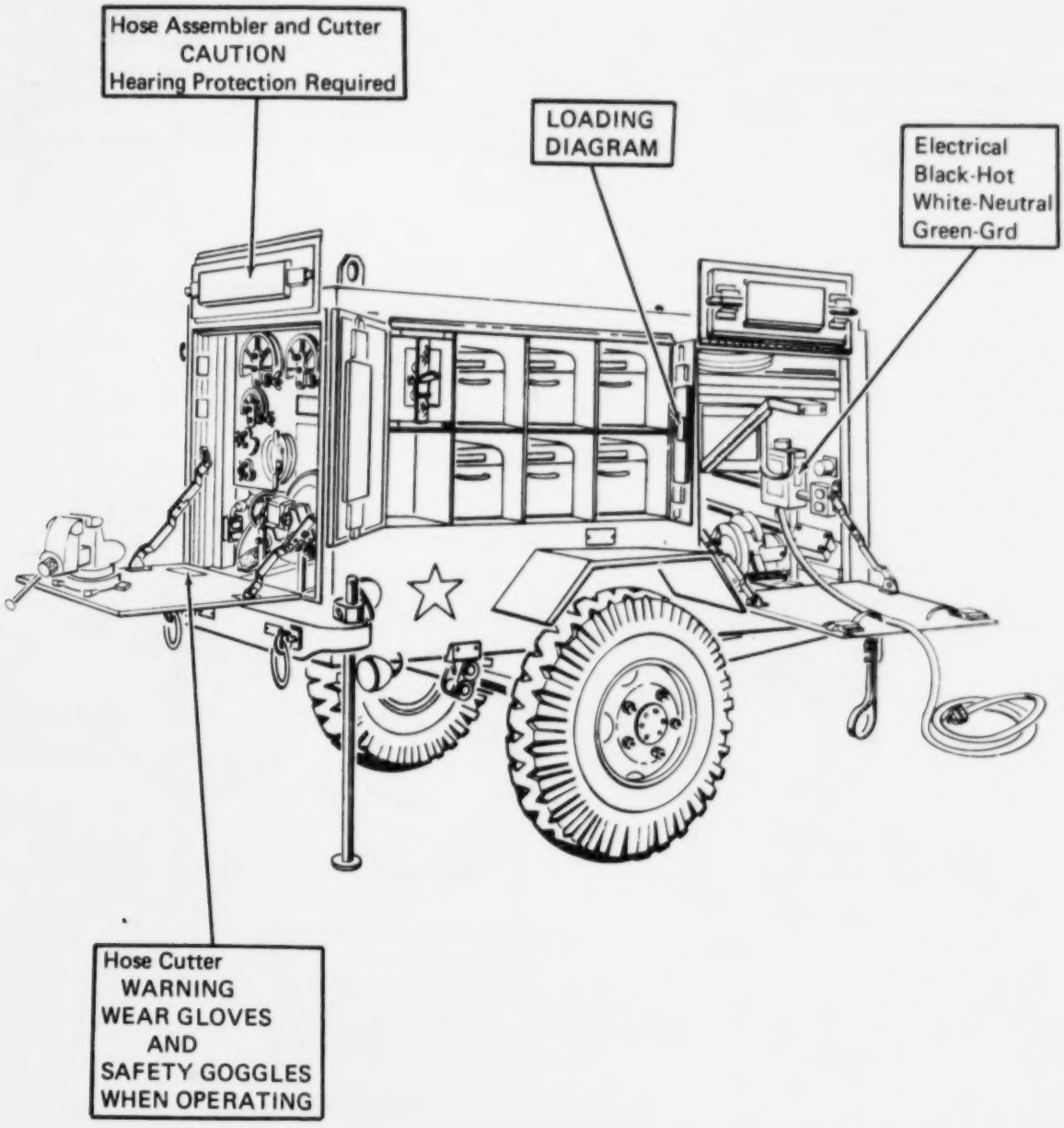


Figure 1-9. HSTRU Data Plates, Curb Side, Doors Open.

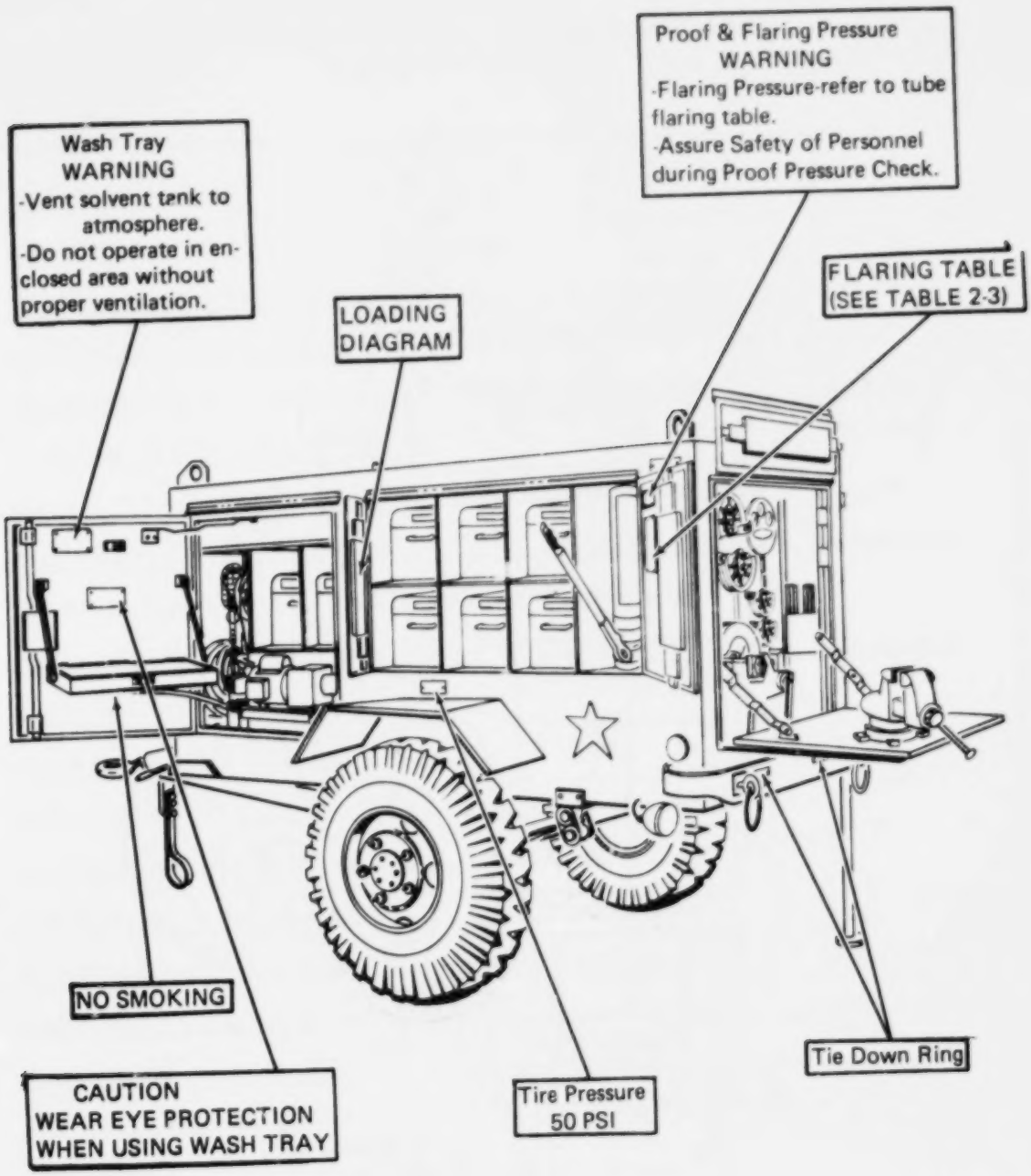


Figure 1-10. HSTRU Data Plates, Street Rear, Doors Open.

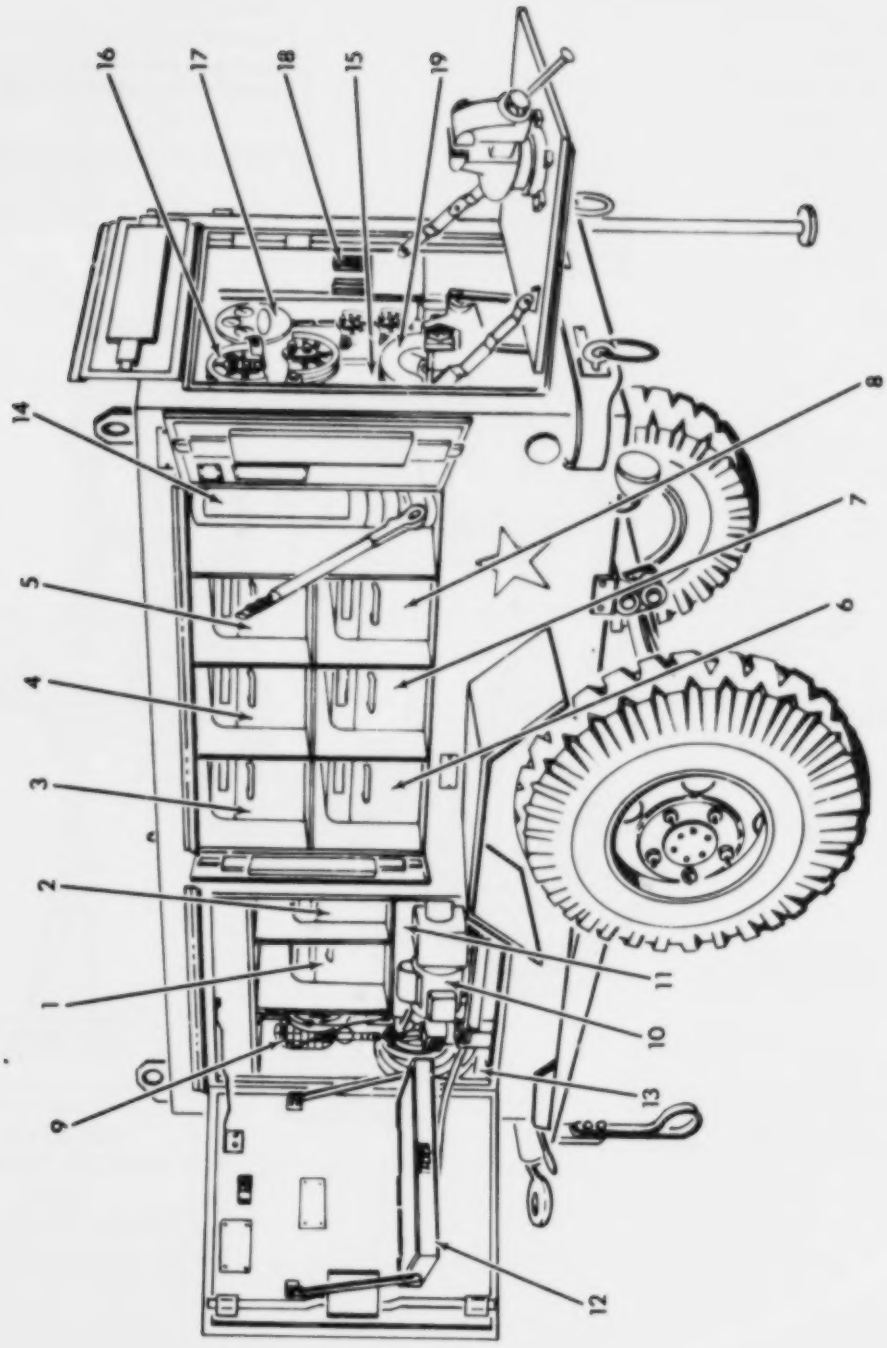


Figure 1-11. Sheet 1 of 2.

LOCATION AND DISTRIBUTION OF HSTRU COMPONENTS
(Figure 1-11, Sheet 1 of 2)

The HSTRU is a trailer mounted unit. Doors open to provide access to the tool stowage and work areas.

HOSE ADAPTER KIT NO. 1. (1). Contains hose fittings.

TUBE FITTING KIT NO. 2. (2). Contains tube fittings.

OPEN END AND ADJUSTABLE WRENCHES, SCREW DRIVERS, PLIERS, MEASURING TOOLS, STOP WATCH, FILES, HAMMERS, SAW AND PRY BAR. (3).

FERRULE SETTING TOOLS, IMPACT WRENCH AND ACCESSORIES, CUT-OFF SAW ACCESSORIES, KEY WRENCHES AND MOTOR BRUSHES. (4).

SEALANT, LUBRICANTS AND VISE JAW CAPS. (5).

ADAPTER KIT EQUIPMENT TPOUBLE SHOOTING. (6). Contains adapter fittings, general replacement and companionable items for connecting HSTRU equipment to any hydraulic system.

BOX END WRENCHES, SNAP RING PLIERS, LARGE SCREW DRIVERS AND SLIP JOINT AND NEEDLE NOSE PLIERS. (7).

FILTER ELEMENT KIT. (8). Used with transfer pump.

DROPLIGHT. (9). 25 feet long, 100 watt bulb.

TRANSFER PUMP. (10). Used to evacuate or fill hydraulic systems.

TUBE BENDER. (11). Hand operated.

SOLVENT WASH RACK. (12). Used for cleaning parts of hydraulic components.

WASH PUMP WITH RESERVOIR. (13). Supplies solvent under pressure to the solvent wash rack.

HANDPUMP AND PRESSURE GAGE. (14). Supplies pressure to the hydraulic flaring tool, and for hydrostatic testing of components.

HOSE COUPLING ASSEMBLER CHUCK BAR. (15). Used with (19) below.

TUBE BENDER RADIUS BLOCKS. (16). Used with (11) above.

MULTI-RANGE PRESSURE GAGE. (17). Used for measuring hydraulic pressure.

TUBE BENDER SLIDE BLOCKS. (18). Used with (11) above.

HOSE COUPLING ASSEMBLER. (19). Used to remove and install hose couplings.

LOCATION AND DESCRIPTION OF HSTRU COMPONENTS

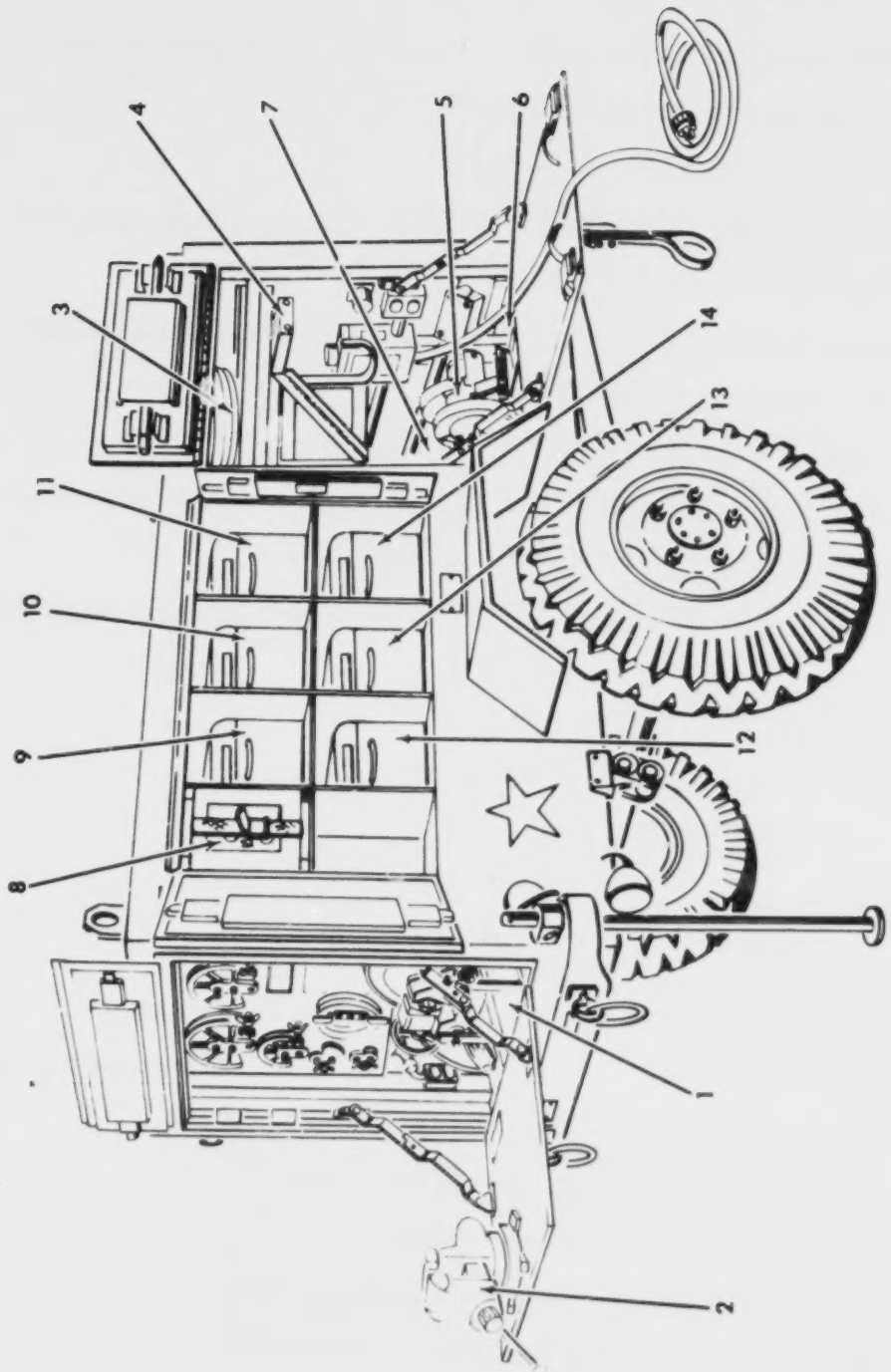


Figure 1-11, Sheet 2 of 2.

LOCATION AND DISTRIBUTION OF HSTRU COMPONENTS
(Figure 1-11, Sheet 2 of 2)

SPARE TUBING. (1). Carbon steel tubing in assorted sizes.

VISE. (2). Provides a mounting base for the tube bender, flaring tool, cutoff saw, and general use.

SPARE HOSE. (3). Two wire braid and four wire spiral wrap.

GROUND STAKES. (4). Used to provide an electrical ground.

HOSE CUTTER. (5). Used to cut hose.

GROUND CABLE. (6). Used with (4) above.

FIRE EXTINGUISHER. (7). Portable.

SYSTEMS FLUSHING FILTER. (8). For flushing contaminated systems.

O-RING KITS. (9). Used to fabricate O-rings not stocked in the standard kit.

OIL CAN, FUNNEL AND REPLACEMENT LAMPS. (10). Cans are used to carry lubricant for the flaring tool, hose coupling assembler, and for filling the proof pressure tester.

CIRCUIT TESTER KIT. (11).

TUBE CUTTING VISE. (12). Used to ensure a clean, square cut.

GOGGLES AND GLOVES. (12). Used for tubing preparation.

TACHOMETER. (12). Resonant reed type.

TOOL KIT. (12). Includes the skiving tool and assorted hand tools.

HOSE ADAPTER KIT NO. 2. (13). Used for hydraulic system analysis.

TUBE FLARING KIT. (14). Used for flaring tubing.

Table 1-2. HSTRU Performance Data

Fluid Capacities	
Solvent Reservoir	5 gallons
Hand Pump	2.5 quarts
Fording Depth, Maximum	24 in.
Major Components	
Hose Coupling Assembler	3/16 through 2 in. hose coupling
Hose Cutting Saw	2 in. Capacity (4 spiral wrap)
Tube Flaring Tool	1 1/4 in. capacity
Tube Bender	1 1/4 in. capacity
Impact Wrench	1/2 in. drive 2000 impacts per minute
Motor Characteristics	
Hose Cutting Tool	5200 RPM 2-1/2 HP
Transfer Pump	3450 RPM 1/3 HP
Circulating Pump	1/15 HP
Impact Wrench	1800 RPM
Hose Coupling Assembler	1/2 HP
Operating Temperatures (Ambient)	-25°F to 120°F
Power Requirements	5 Killowatts
Voltage	120 VAC 60 Hz
Pump Characteristics	
Circulating	500 GPH 7.5 PSI

Table 1-2. HSTRU Performance Data (continued)

Transfer	3.5 GPM 100-125 PSI
Hand	10,000 PSI
Tire Pressure	50 lb. PSI
Weight and Dimensions	
Weight (overall)	3000 lb.
Length	151 in.
Width	75 in.
Height	76 in.
Maximum Towing Speed	
Highway	55 MPH
Cross Country	30 MPH (Maximum Safe Speed)

Section III

TECHNICAL PRINCIPLES OF OPERATION

1-8. General. The primary use of the HSTRU is for repairing faults in hydraulic systems. In order to accomplish this, a number of components for test and repair of hydraulic systems, have been installed in the HSTRU. The following paragraphs briefly describe the technical principles of operation of those components.

1-9. Tools. The HSTRU is equipped with the following tools:

a. Hose cutting saw and skiving tool

b. Hose coupling assembler

c. Tube cutting, deburring, and bending tools

d. Multi-range pressure gage

e. Hydraulic tester (temperature, flow, and pressure)

f. Hydraulic flaring tool

g. Vise

h. Hydraulic hand pump

i. Cleaning and flushing equipment

j. Hand tools and support items normally required

1-10. Functions.

a. Hydraulic Plumbing and Repair Tools. Hydraulic plumbing failure has proved to be the main cause of hydraulic equipment down time. Hydraulic plumbing is usually exposed to external abuse and is highly susceptible to damage. Because of this, tubing and hose repair equipment are very important items in the HSTRU.

b. Hose Assembly Fabrication. Hose assembly fabrication is divided into four areas: hose cutting, hose end preparation for receipt of the coupling, hose cleaning, and hose coupling assembly.

(1) Hose Cutting. A 120V, electric power saw with a friction burn blade is installed in the HSTRU for hose cutting (see Figure 1-12).

NOTE

A HACKSAW WITH ABRASIVE BLADE HAS BEEN INCLUDED IN TOOL BOX NO. 3 FOR HOSE CUTTING WHEN ELECTRICAL POWER IS NOT AVAILABLE.

This power saw is capable of cutting hose as heavy as four wire heavy spiral (R10) in sizes up to two inches I.D.

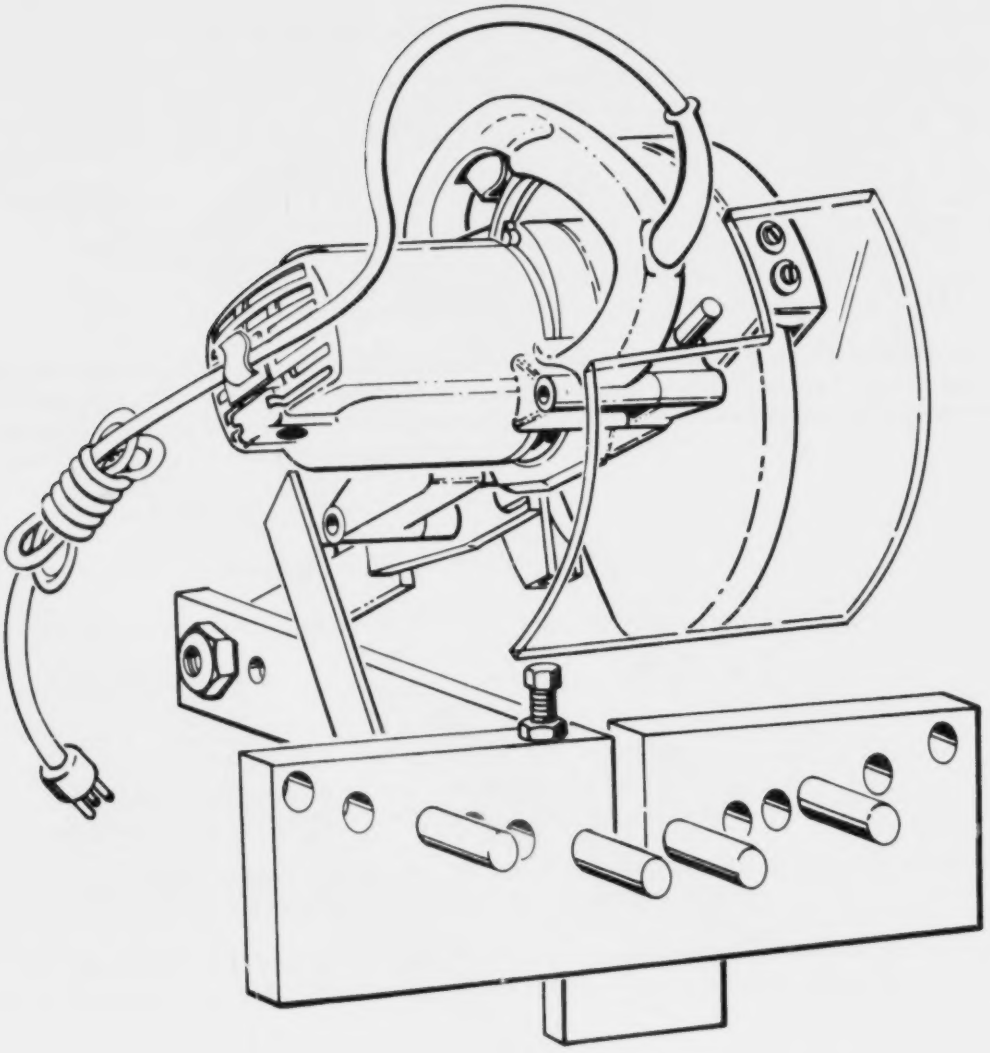


Figure 1-12. Hose Cutting Saw.

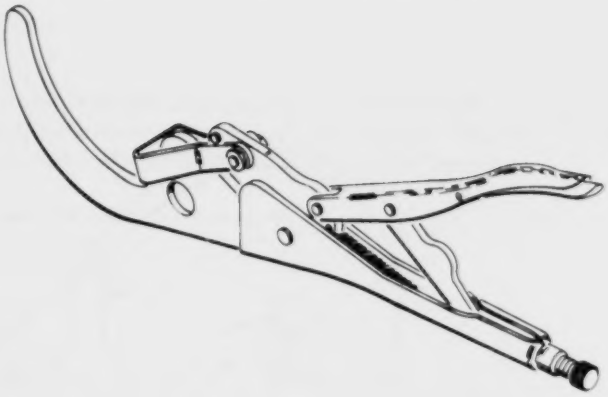


Figure 1-13. Hose Skiving Tool.

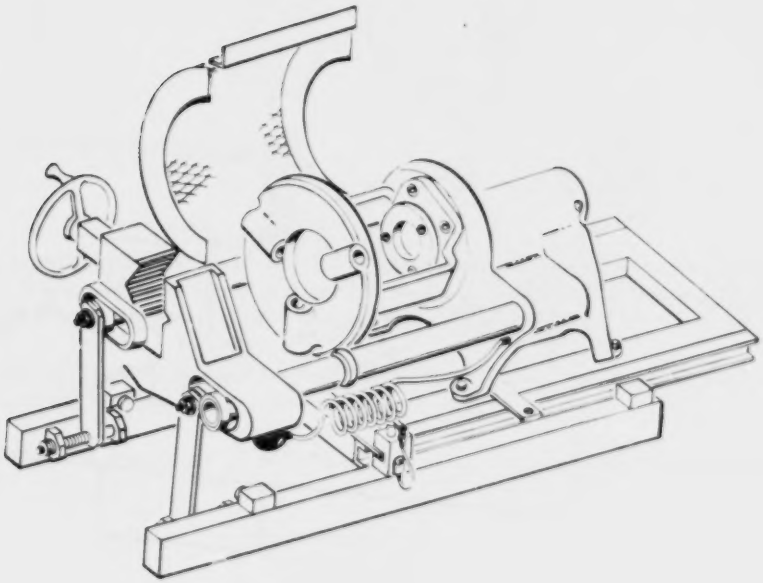


Figure 1-14. Hose Coupling Assembler.

(2) Hose end preparation. Hose end preparation (skiving) involves taking the rubber cover from the hose, near the end. This is done so that the hose coupling can grip the wire reinforcement. In the HSTRU, skiving is done with a skiving tool (see figure 1-13). This tool clamps over the outside diameter of the hose and has a knife edge set parallel to the hose centerline. Rubber strips are peeled off with each twist of the tool around the hose circumference. The skiving tool can be set for any hose up through 2 in. I.D. by a simple screw adjustment. The cutting blade can be sharpened with a file. A spare blade is stored in the box with the skiving tool.

(3) Hose cleaning. The solvent wash system, in the forward left hand compartment, is used for cleaning hose after cutting. The hose should be thoroughly washed to remove dirt, chips or other materials which might cause hydraulic system contamination or leakage at a sealing surface.

(4) Hose coupling assembly. Hose coupling assembly in the HSTRU is accomplished by the use of a hose coupling assembler (see figure 1-14). This is a screw-together type machine which allows the reuse of the old coupling. The hose coupling assembler slides out over the rear work table and locks into place for use.

NOTE

COUPLING MAY BE ASSEMBLED WITH A VISE AND HAND TOOLS WHEN ELECTRICAL POWER IS NOT AVAILABLE.

The Hose Coupling Assembly Tool is a power machine which facilitates the attachment of reusable fittings onto hydraulic system hose. It readily handles all types of hose couplings from size 3/16 inch through 2 inch I.D., including bent tube elbows. The unit is powered by a 1/2 horsepower, 120 VAC motor. A pneumatically operated hand switch is provided for safe, easy, and efficient operation. Some of the features are:

Positive lock chuck with removable handle.

Reversible switch for assembly and disassembly.

Conveniently operated, moveable handwheel vise (self centering).

Positive grip vise jaws.

Chuck for use with regular or bent tube end nipples.

Safety guard protects operator and blocks the switch when the guard is opened.

c. *Tube Assembly Fabrication.* Tube assembly fabrication is divided into five areas; tube cutting, tube deburring, tube cleaning, tube bending, and tube flaring. Tube size ranges are 1/4" through 1-1/4".

(1) Tube cutting. A crosscut vise (see figure 1-15) is provided in the HSTRU to hold tubing to assure a square cut with a hacksaw. This vise may be placed on a work table or clamped in the machinists' vise which is mounted at the back of the trailer.

(2) Tube deburring. Deburring tool (figure 1-16) is provided for removing burrs from the inner and outer edges of the tube. With this tool, burrs may be removed with a few twists of the wrist. The tool is equipped with replaceable blades.

(3) Tube cleaning. The solvent wash system in the forward left hand compartment is used for cleaning hydraulic tubing after cutting and deburring. The tubing should be cleaned thoroughly to remove dirt, burrs, or other materials which might cause hydraulic system contamination or create leakage paths.

(4) Tube bending. Tube bending capability in the HSTRU is provided by a mechanical tube bender (figure 1-17). This tool is hand crank operated. Individual radius blocks and associated slide blocks are included to provide bends of up to 180°.

(5) Tube flaring. Tube flaring in the HSTRU is accomplished by a hydraulically operated tube flaring device. This tool is pictured in figure 1-18. This unit automatically grips the tube in tapered clamping blocks. At the same time, it also forces a tapered pin into the tube inside diameter. This produces the flare. The hydraulic pressure is provided by the use of the hand pump.

d. Multi-range Pressure Gage. In many cases a hydraulic malfunction can be isolated by accurate pressure measurement. High and low system pressures are usually measured during fault isolation. The multi-range pressure gage in the HSTRU has three gages contained in a single housing (figure 1-19). Each gage automatically shuts itself off if the pressure exceeds its measuring capability. This protects the low pressure gages from excessive pressure. The system also has a vacuum measurement capability for measuring pump inlet pressure. The multi-range pressure gage has a range from 30 inches of Mercury (vacuum) to 5,000 PSI (pressure).

e. Hydraulic Systems Tester. Conditions which may be measured when diagnosing a hydraulic system malfunction are pressure, flow, and temperature. When it is to be used, the tester (figure 1-20) is connected into the hydraulic system being tested, and fault diagnosis is made by a logical sequence of loading a hydraulic circuit and measuring pressures, flows, and temperatures. In this manner, pressure settings can be determined, internal leakage can be measured, and malfunctioning components and hot spots can be found. This tester measures temperatures from 50° to 240°F, flows from 1 to 100 GPM, and pressures from 200 to 6000 PSI. The tester weights about thirty pounds.

f. Hydraulic System Flushing Unit. A filter assembly (figure 1-21) and bypass indicator (figure 1-22) is provided with the HSTRU. To flush a hydraulic system, connect the flushing unit into the return line of the system being flushed. Use the pump of the unit being flushed to provide the flow. If the flow rate of the pump exceeds the flow rating of the flushing unit, the fluid bypasses the filter. When this happens, the indicator shows that the filter has been bypassed (figure 1-23). The hydraulic circuit pump speed should be reduced to an acceptable level (one which does not cause the hydraulic fluid to bypass the filter). Using this method, a contaminated hydraulic system can be flushed in twenty to thirty minutes.

g. Transfer Pump. The HSTRU is equipped with a lightweight transfer pump (figure 1-24). This pump may be used to transfer hydraulic fluid from one reservoir to another during the repair process. The transfer pump is a 3.5 GPM electrically driven pump. It has a 1/3 HP, 120 VAC 60 Hz electric motor.

h. Proof Pressure Tester. A standard 0 to 10,000 PSI hand pump (figure 1-25) has been installed in the HSTRU as a proof pressure tester. Two pump pistons operate simultaneously until load contact is made. The larger piston cuts out automatically for high pressure operation.

i. Wash Rack. A lightweight solvent wash unit (figure 1-26) includes a shallow wash tray suspended from the front left inside door panel, a circulating pump, a filter, a fluid reservoir with a cleanout port, and external ventilation. The pump has a rating of 500 GPH. It is driven by a 1/15 HP electric motor. This motor is oil immersed for environmental protection. The pump output line terminates in a variable flow nozzle. This nozzle helps prevent splashing.

j. Adapter Kit. Some equipment does not have any hydraulic system testpoints. When test points are installed, they frequently are 1/8 or 1/4 inch pipe, or 1/4 inch O-ring ports. These test points are too small for the hydraulic system tester. For this reason, an adapter kit (figure 1-27) has been included in the HSTRU. The adapter kit makes it possible to use the hydraulic system tester and pressure gages to test hydraulic systems. The kit has all the tees and adapter fittings required to adapt any hydraulic system to the 1/8 NPT gage connection and the 1 inch, 37 degree flare tester connection. The kit also has the fittings required to adapt hose and tubing to the hand pump for Proof Pressure Testing.

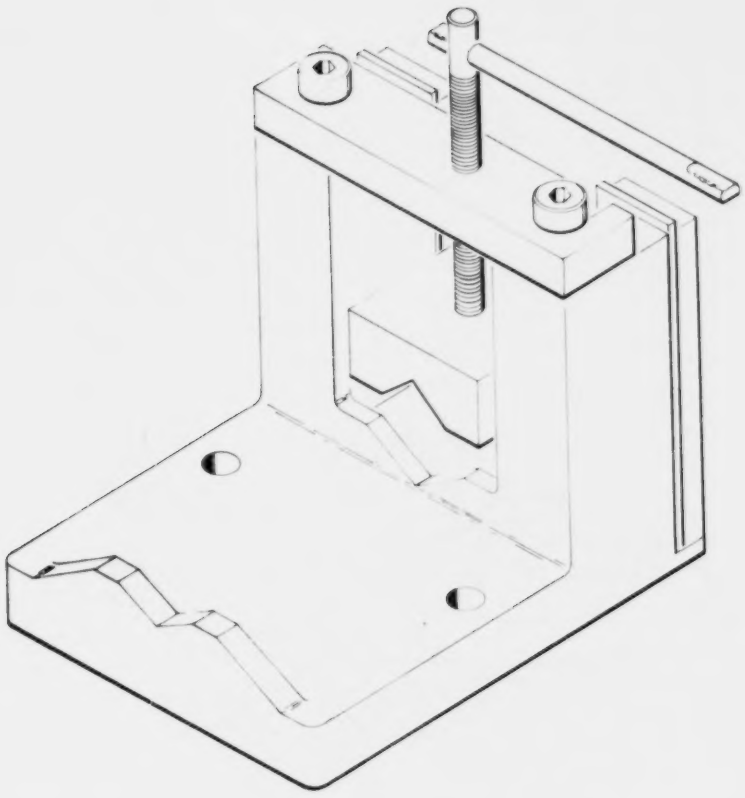


Figure 1-15. Crosscut Vise.

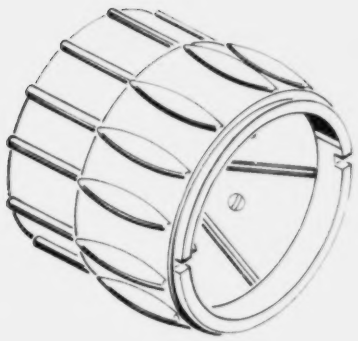


Figure 1-16. Deburring Tool.

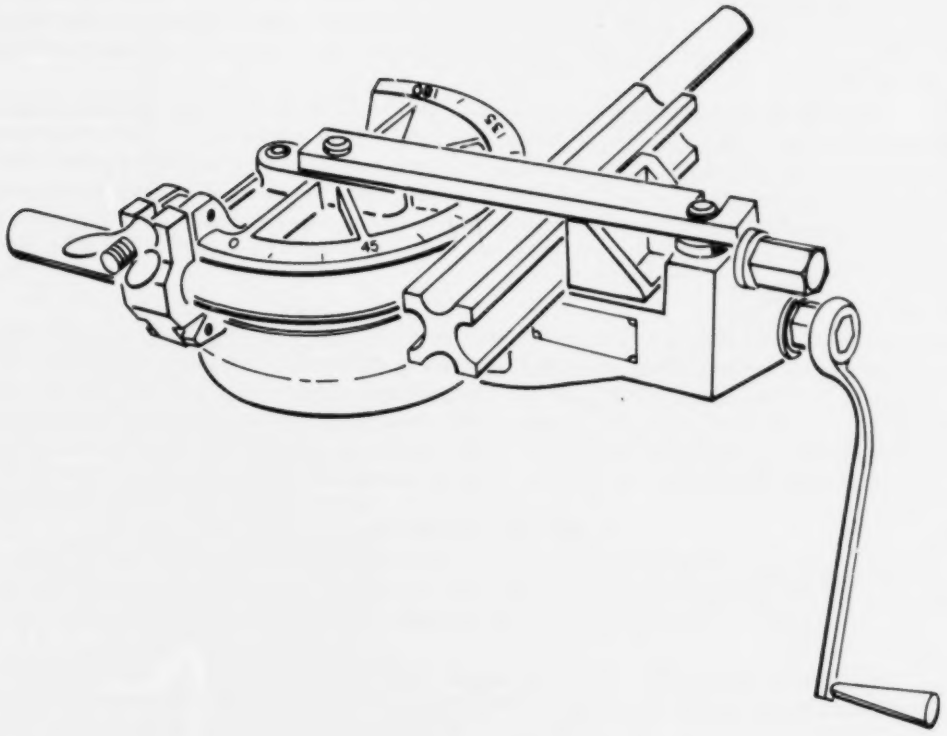


Figure 1-17. Tube Bender.

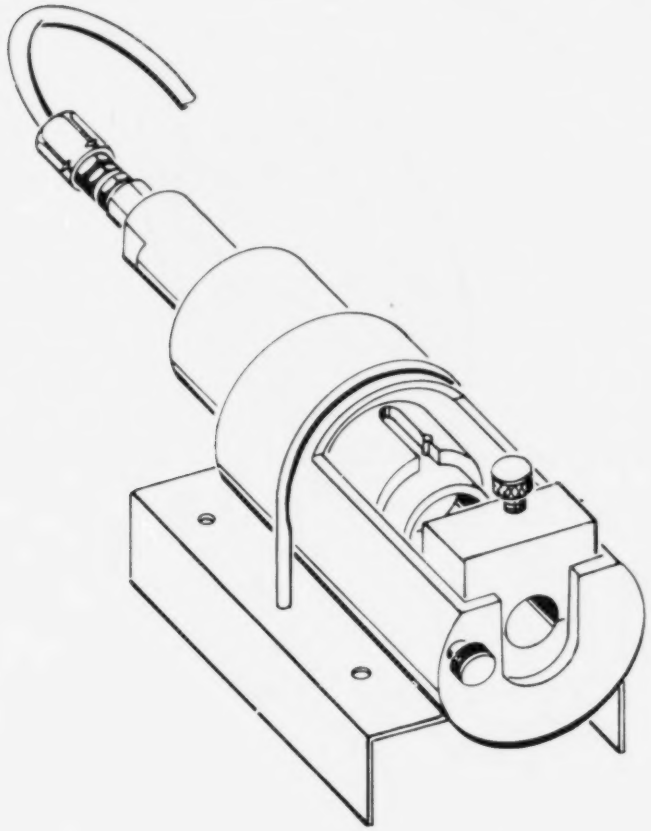


Figure 1-18. Tube Flaring Tool.

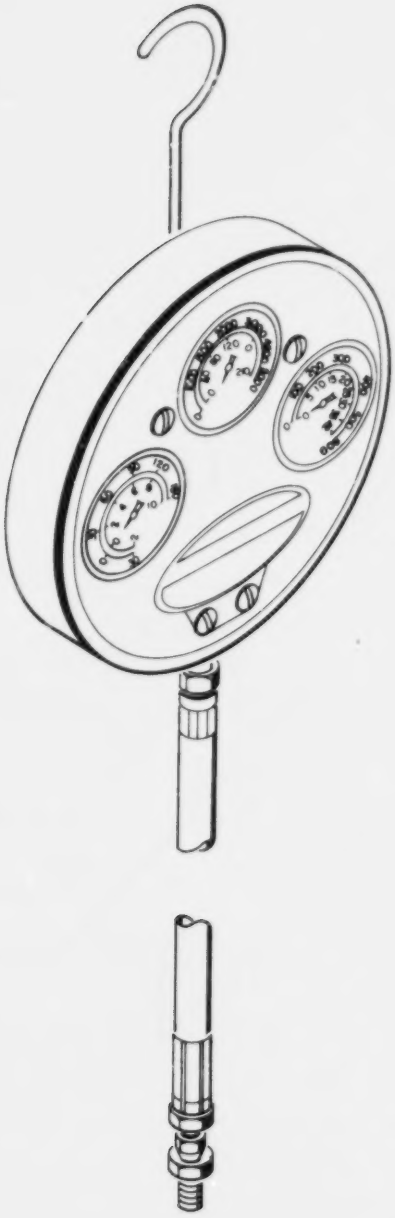


Figure 1-19. Multi-Range Pressure Gage.

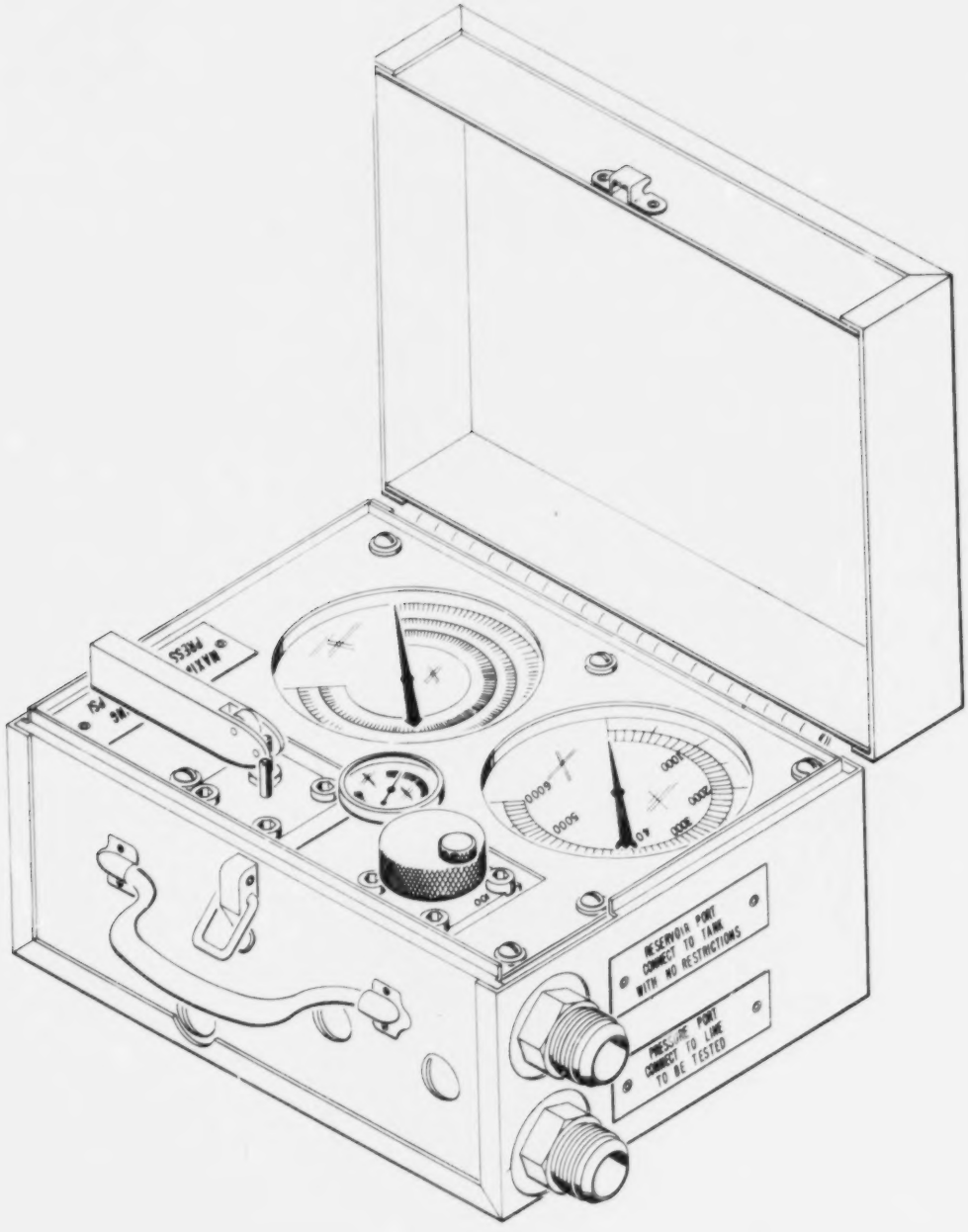


Figure 1-20. Hydraulic Systems Tester.

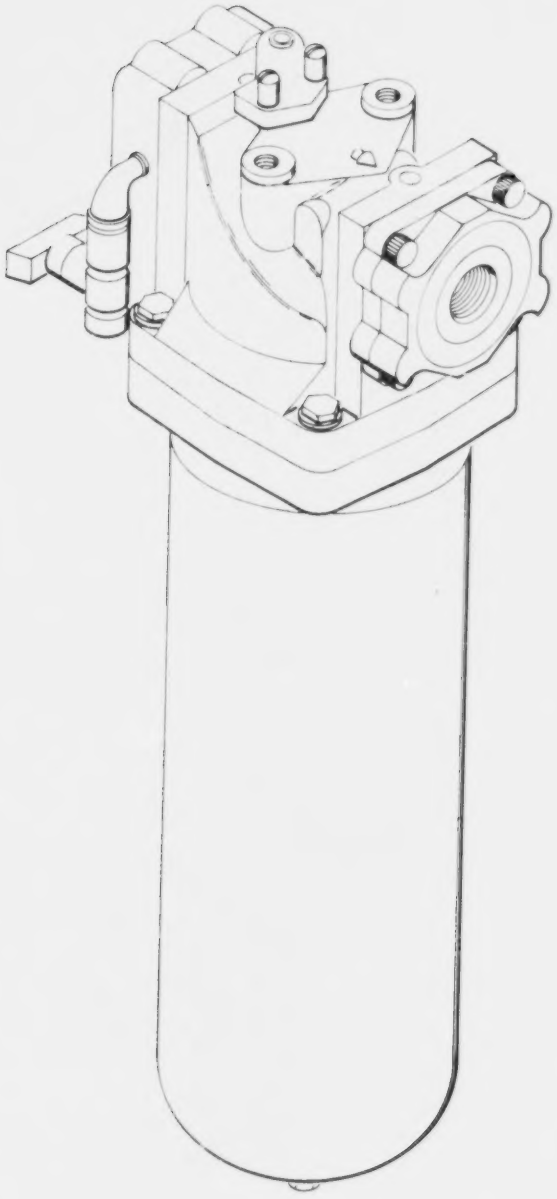


Figure 1-21, Sheet 1 of 2. Hydraulic Systems Flushing Filter (Assembly).

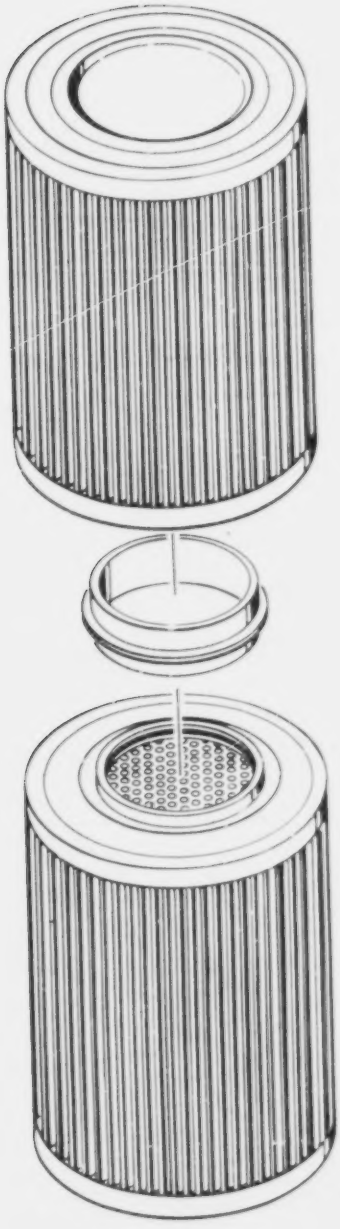


Figure 1-21, Sheet 2 of 2. Hydraulic Systems Flushing Filter (Elements).

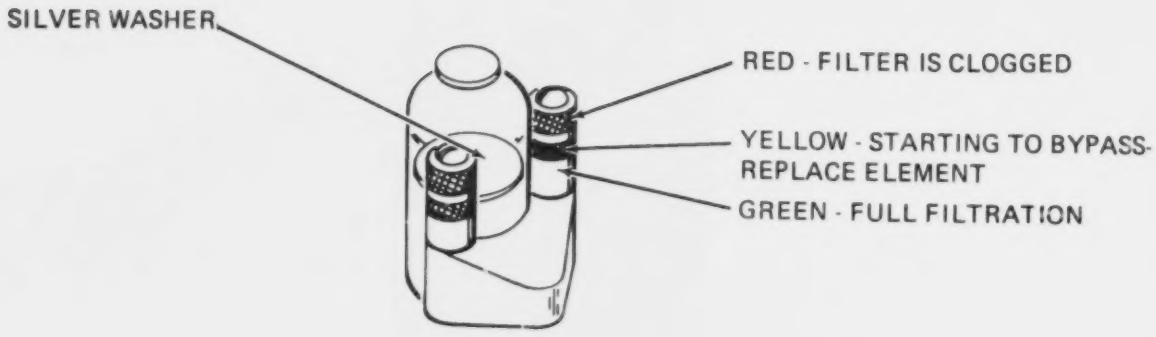


Figure 1-22. Filter Bypass Indicator, Reading Normal.

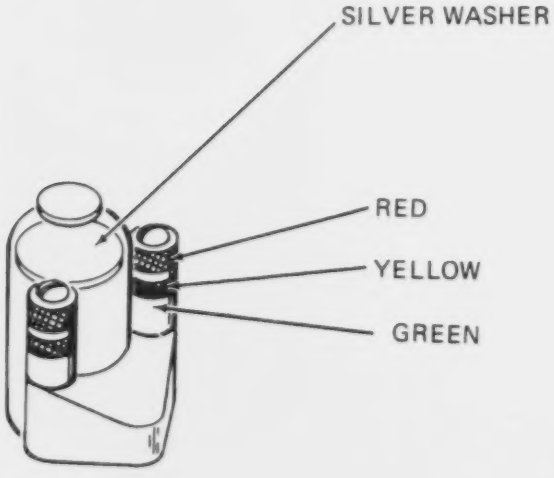


Figure 1-23. Filter Bypass Indicator, Reading Bypassed.

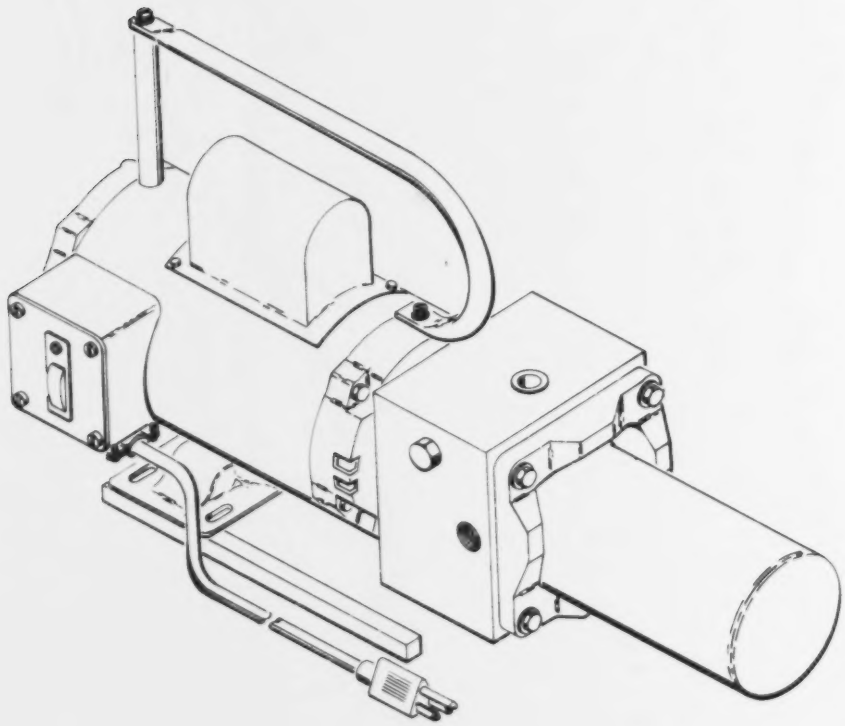


Figure 1-24. Transfer Pump.

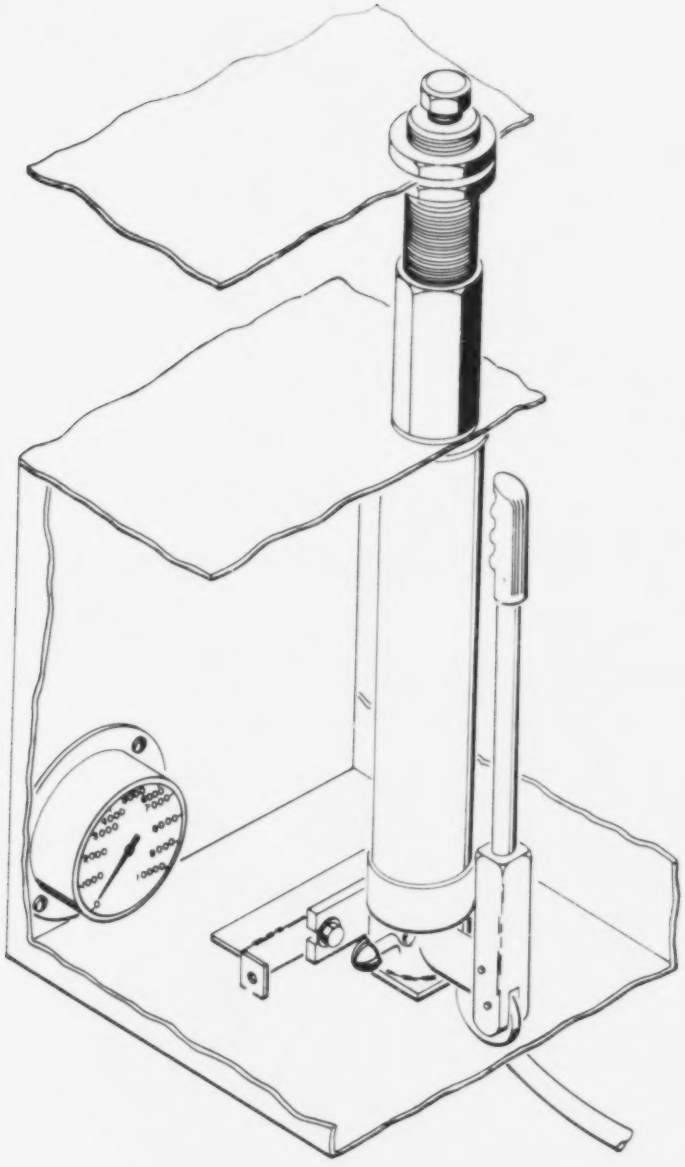


Figure 1-25. Hand Pump.

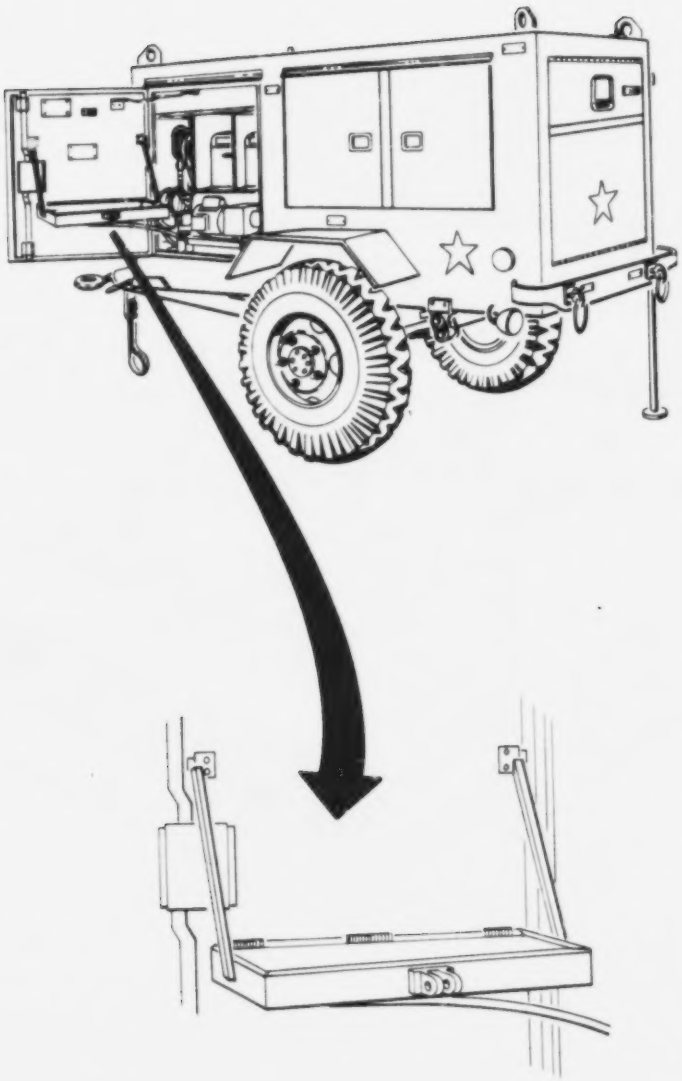


Figure 1-26. Wash Rack.

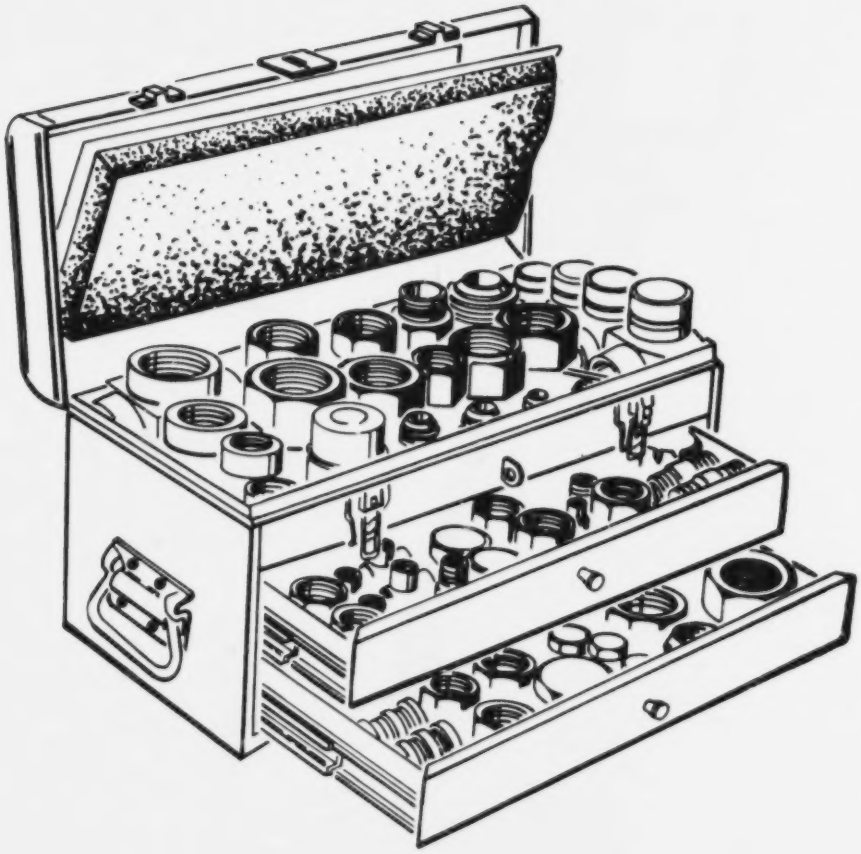


Figure 1-27. Adapter Fitting Kit.

1-11. Electrical Power Connection. The main power supply cable is 50 feet long. It is stowed in the forward right-hand compartment of the trailer. This compartment also has a storage box for the ground stakes (figure 1-28).

1-12. Equipment Storage Arrangement. The hose coupling assembler is slide mounted in the HSTRU (figure 1-29). This allows it to be pulled out and locked in place for use. Small tools, adapters, flare dies, etc. are placed in standard tool boxes and stored on both sides of the trailer (figure 1-30). The area above the storage compartments is a shelf which runs the full length and width of the trailer (figure 1-31). This shelf provides storage for hose supply. Extra lengths of tubing are stored in the bottom of the HSTRU (figure 1-32).

1-13. Miscellaneous Tools and Supplies. The HSTRU contains a drop light (figure 1-33) with a twenty-five foot cord. It also has tool boxes with standard hand tools such as a hacksaw and blades, wrenches, snap ring pliers, etc. Small special tools such as the hose skiving and deburring tools are also included in the tool boxes. A tachometer (figure 1-34) is included. This is used to help the operator maintain the desired engine RPM during testing of engine driven hydraulic systems.

1-14. O-ring Kit. The O-ring Kit (figure 1-35) contains all the O-rings normally required for standard sizes of O-ring boss and four bolt split flange connections.

1-15. O-ring Fabrication Kit. The O-ring Fabrication Kit (figure 1-35) contains the materials necessary to make o-rings. This kit is used when the O-ring Kit does not contain an o-ring which is needed.

1-16. Work Areas. In order to provide adequate work areas, all horizontal surfaces (doors and fenders) will support loads of 200 pounds (figure 1-36).

1-17. Power Requirements. The HSTRU requires only 120 VAC, 60 cycle current. All power tool cords terminate in a three (3) prong plug. The main power supply cord also has a three prong plug.

NOTE

SEE FIGURE 3-1 FOR AN ELECTRICAL SYSTEM SCHEMATIC.

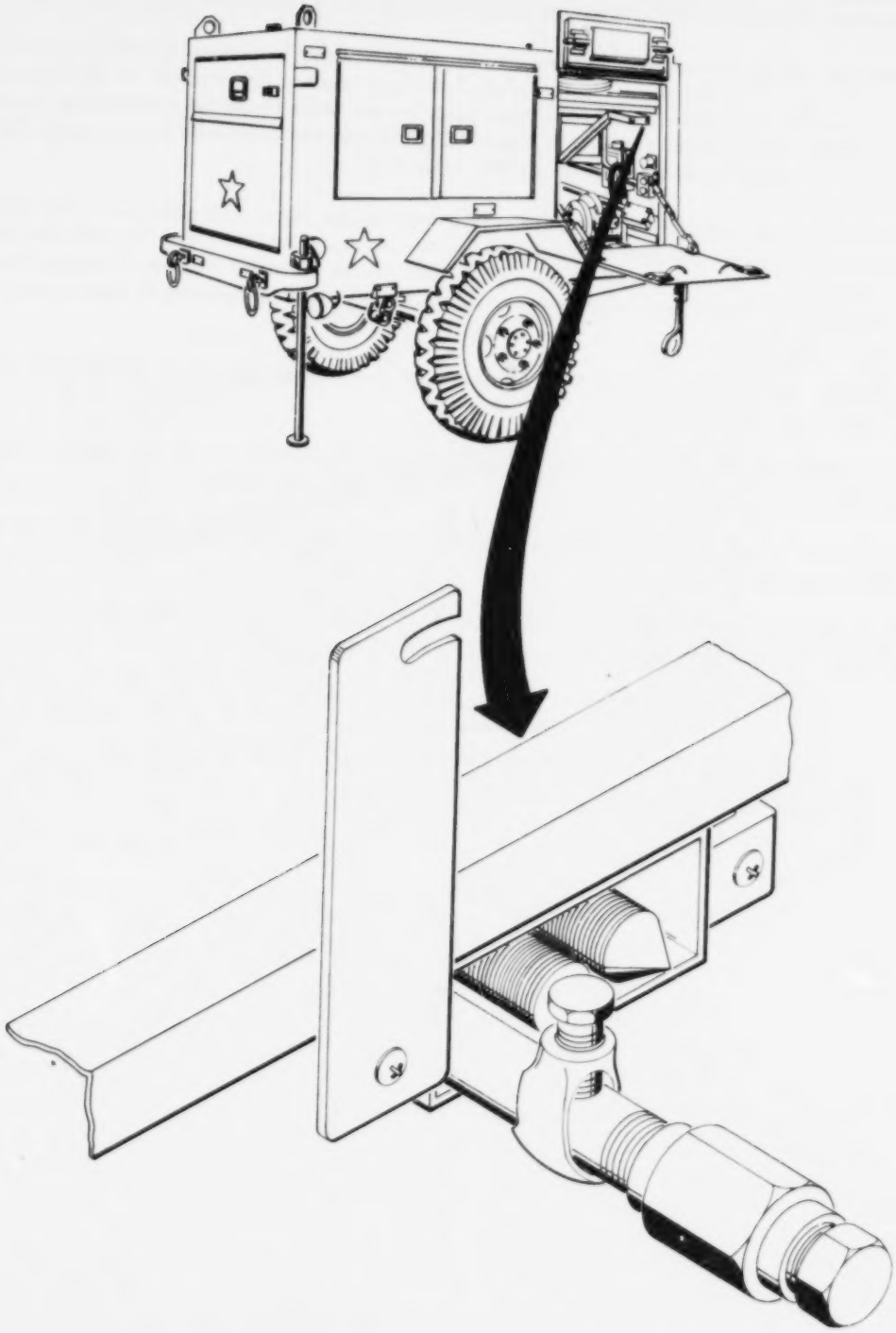


Figure 1-28. Ground Stakes Storage Compartment.

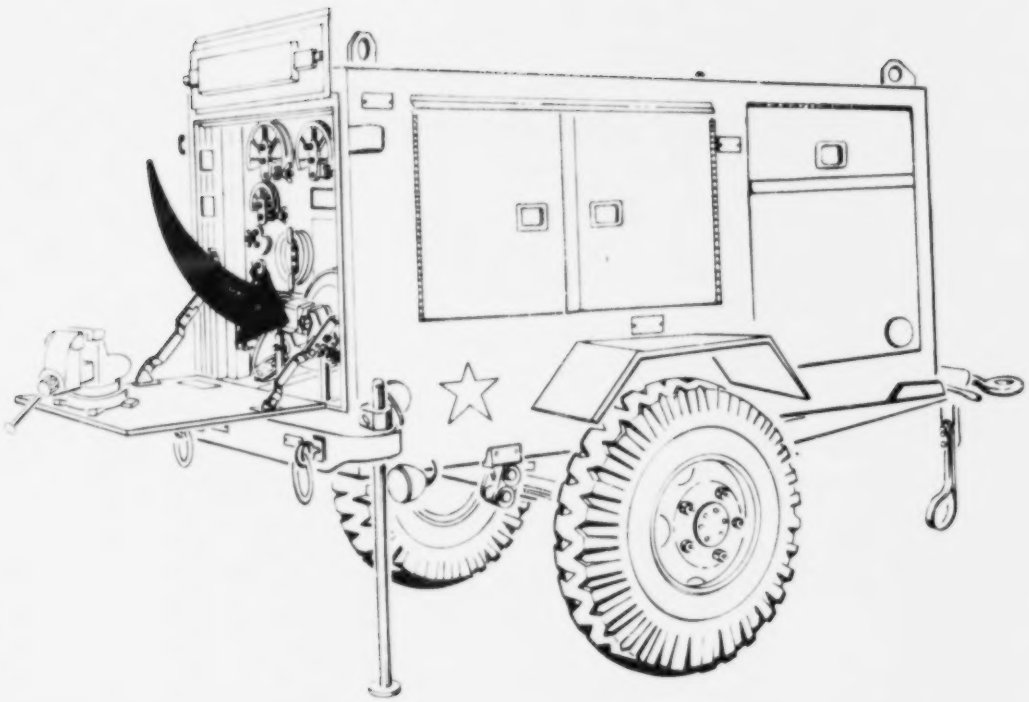


Figure 1-29. Slide Mounted Tool.

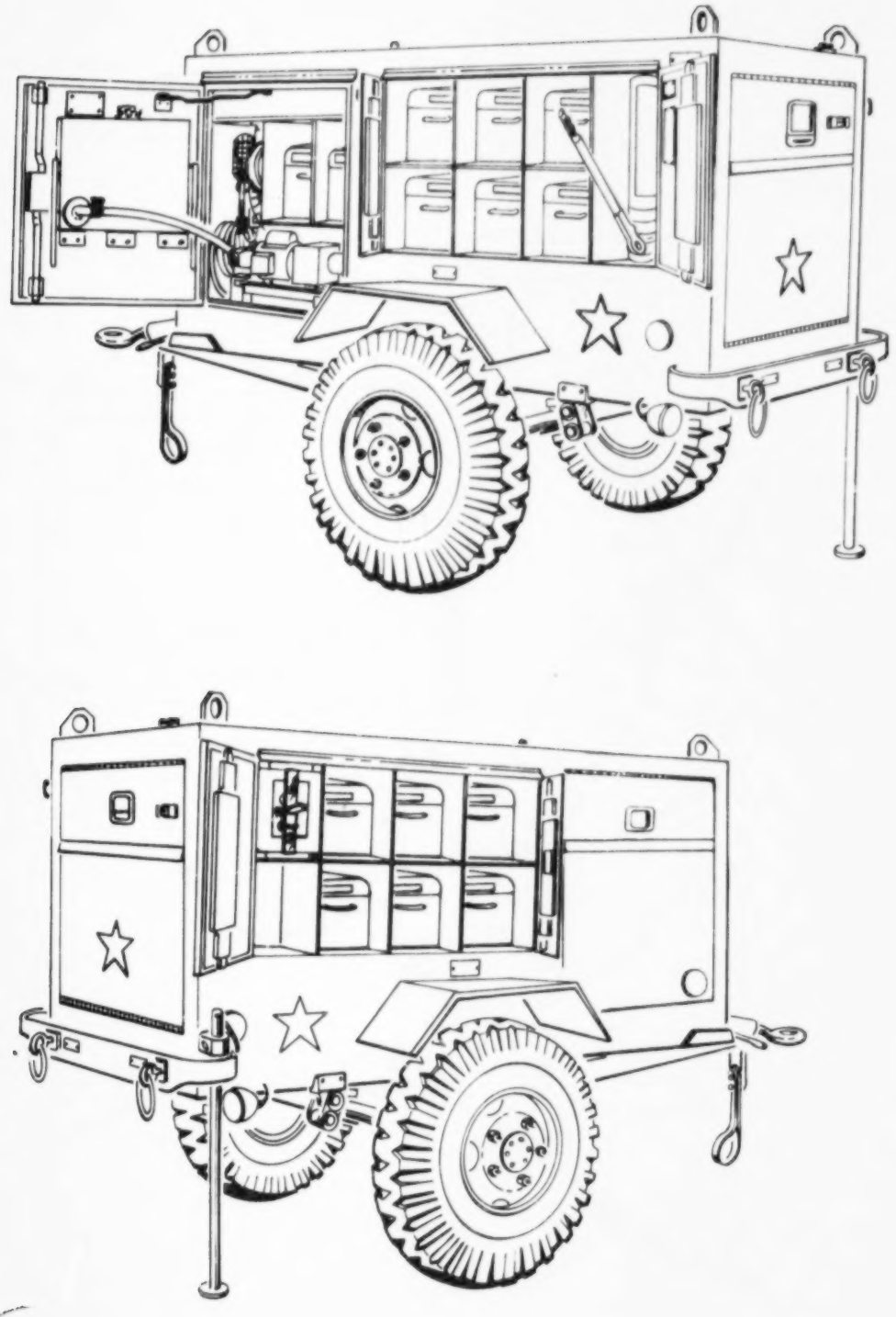


Figure 1-30. Tool Box Storage.

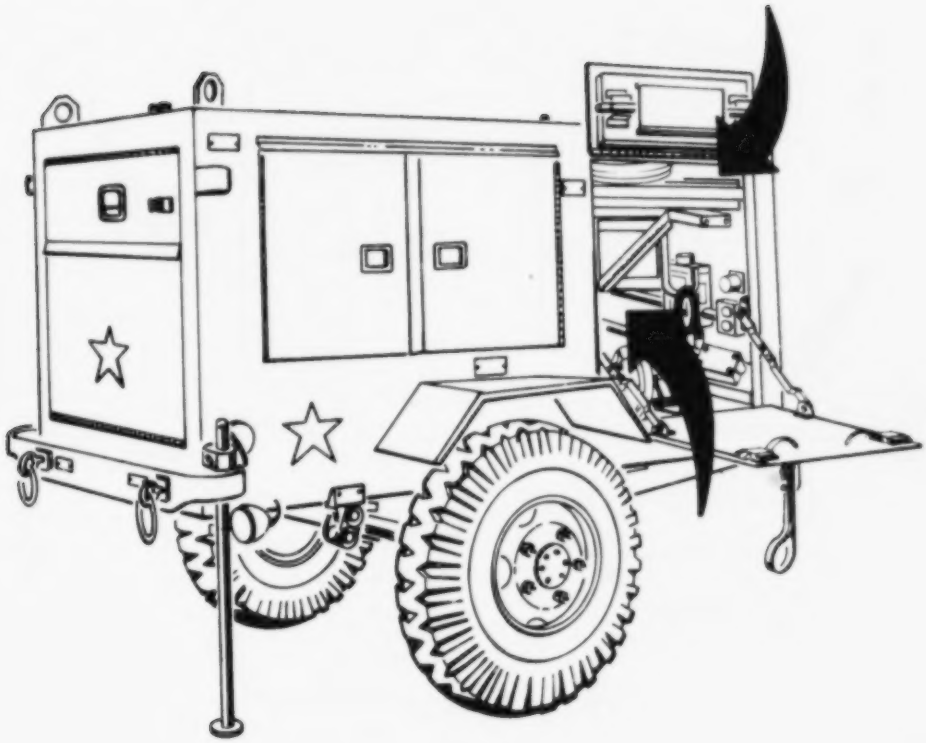


Figure 1-31. Hose Storage.

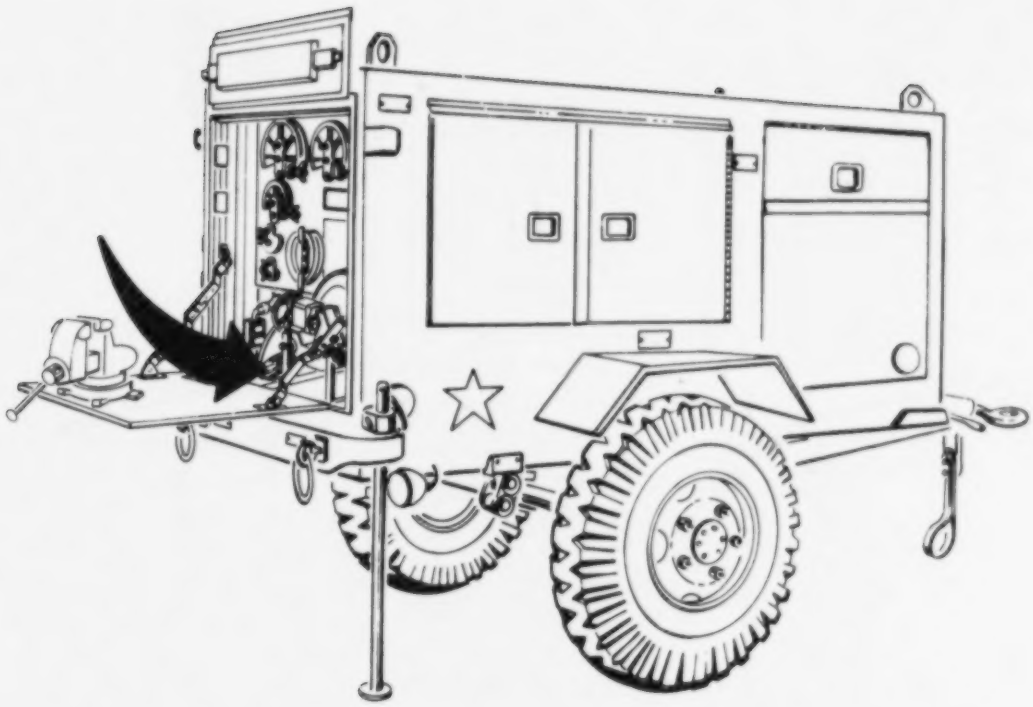


Figure 1-32. Tubing Storage.

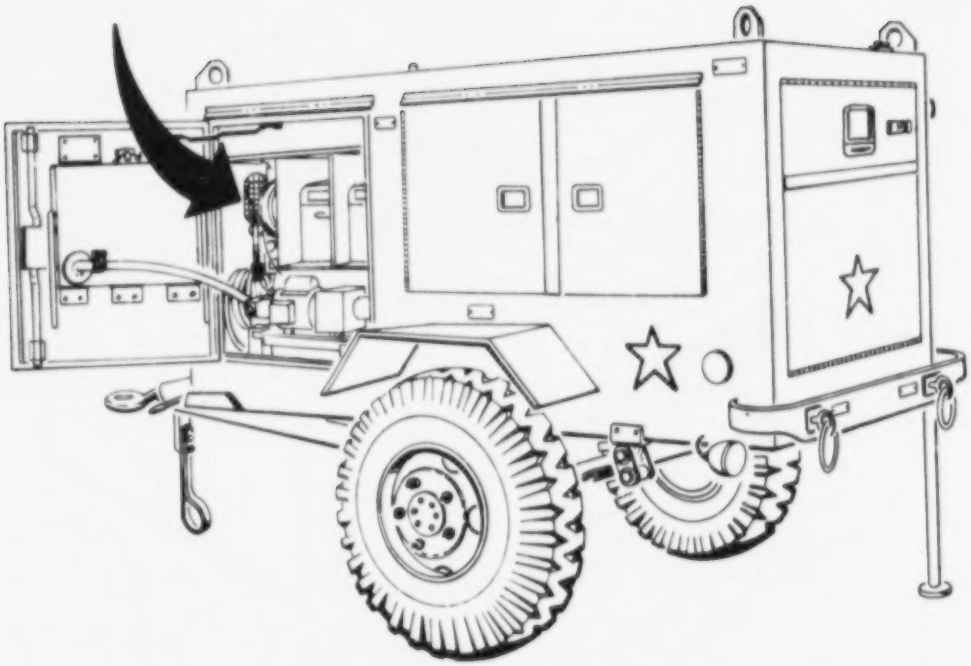


Figure 1-33. Drop Light.

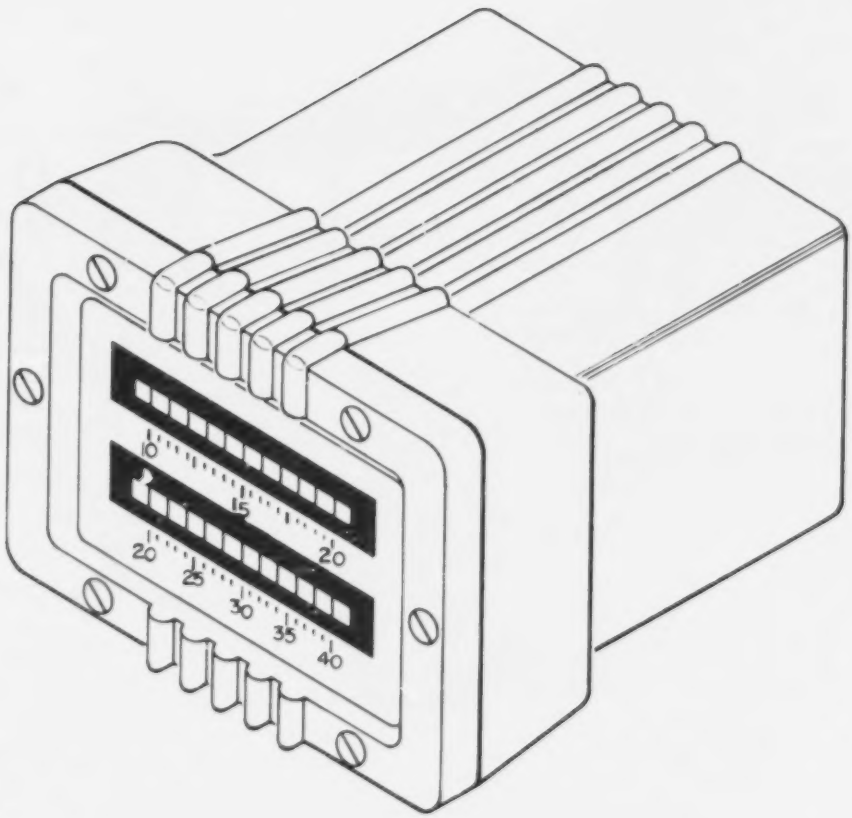


Figure 1-34. Tachometer.

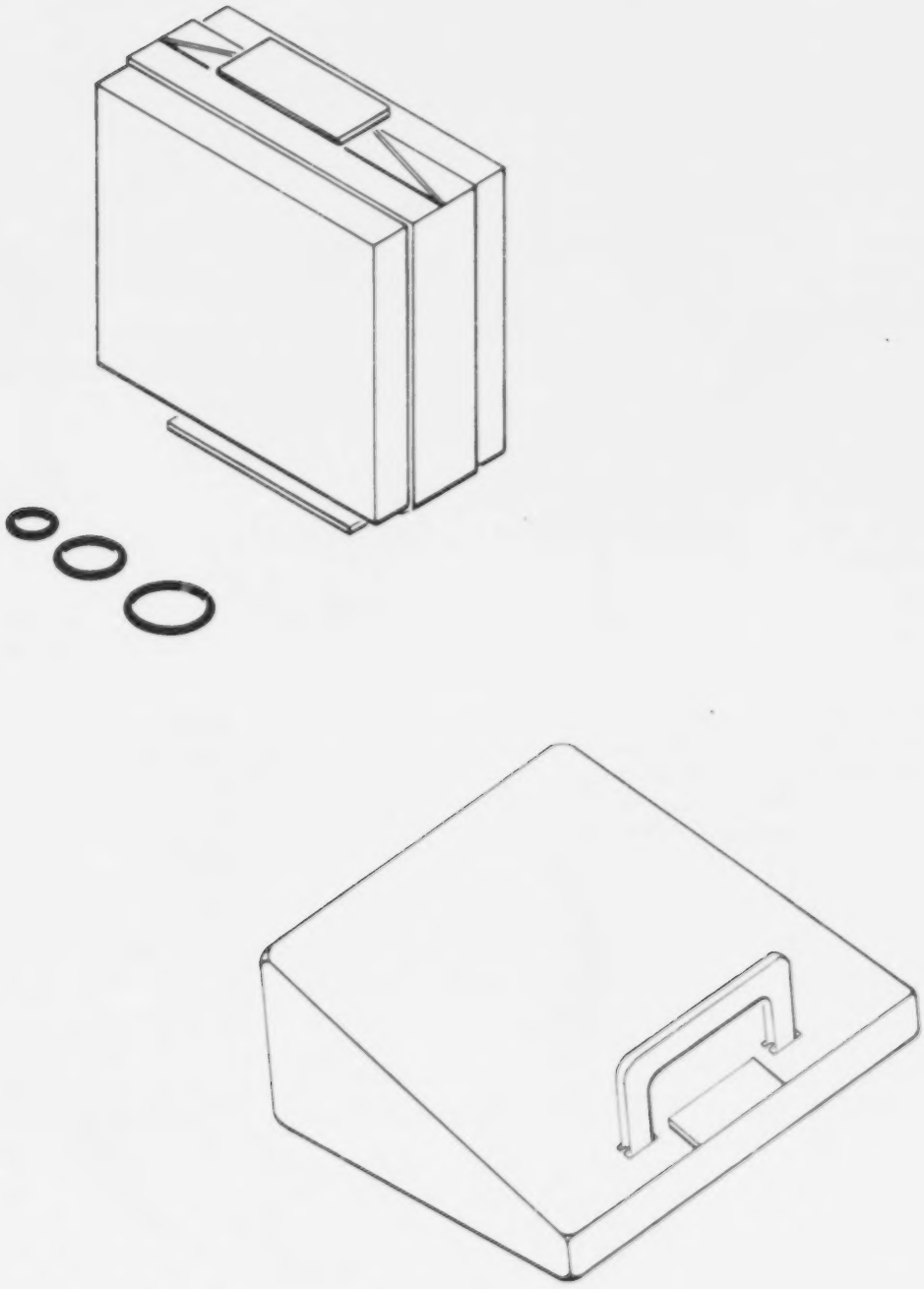


Figure 1-35. O-Ring Kit and O-Ring Fabrication Kit.

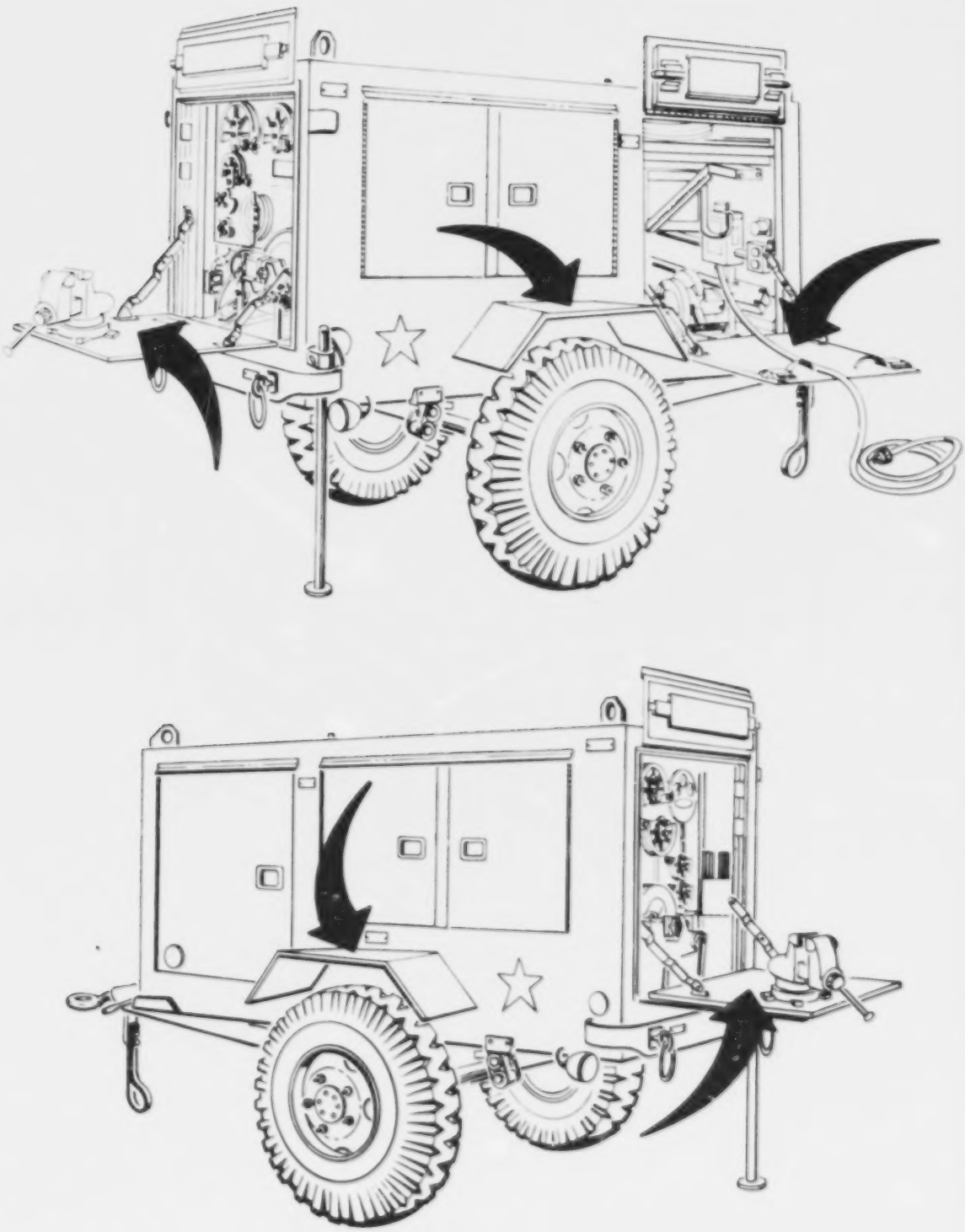


Figure 1-36. Work Areas.

CHAPTER 2

INSTALLATION AND OPERATION INSTRUCTIONS

SECTION I

SERVICE UPON RECEIPT

2-1. General. When you receive the HSTRU, there are some things which you must do to ensure that it is ready for operation. The following paragraphs identify those things and tell you which paragraphs of this manual you should refer to for proper inspection, servicing, and adjustment procedures.

2-2. Inspection. Refer to your "before operation" (B) Preventive Maintenance Checks and Services (PMCS), Chapter 2, Section III of this manual, and perform items 1 through 18.

SECTION II

DESCRIPTION AND USE OF OPERATORS CONTROLS AND INDICATORS

2-3. General. In the HSTRU, operator's controls and indicators are placed near the item or tool which they monitor or control. The controls and indicators in the HSTRU are simple to operate and read. Figure 2-1 through 2-11 show these controls and indicators. Use of these controls and indicators is covered in Section IV, "Operation Under Usual Conditions". Table 2-1 is an index of the control and indicator figures.

Table 2-1. Index of Controls and Indicators

Figure Number	Item
2-1	Hand Pump Flow Control Valve, Handle, and Pressure Gage.
2-2	Hose Cutter Power Switch and Blade Lock Pin.
2-3	Transfer Pump Control and Indicator.
2-4	Tube Bender Controls and Indicator.
2-5	Hose Coupling Assembler Controls.

Table 2-1. Index of Controls and Indicators (Continued)

Figure Number	Item
2-6	Tube Flaring Tool Tube Stop Knob.
2-7	Circuit Breaker and Visual Trip Indicator (Red).
2-8	Tachometer.
2-9	Hydraulic System Tester.
2-10	Multi-Range Pressure Gage.
2-11	Electrical Circuit Hook-Up Indicator.

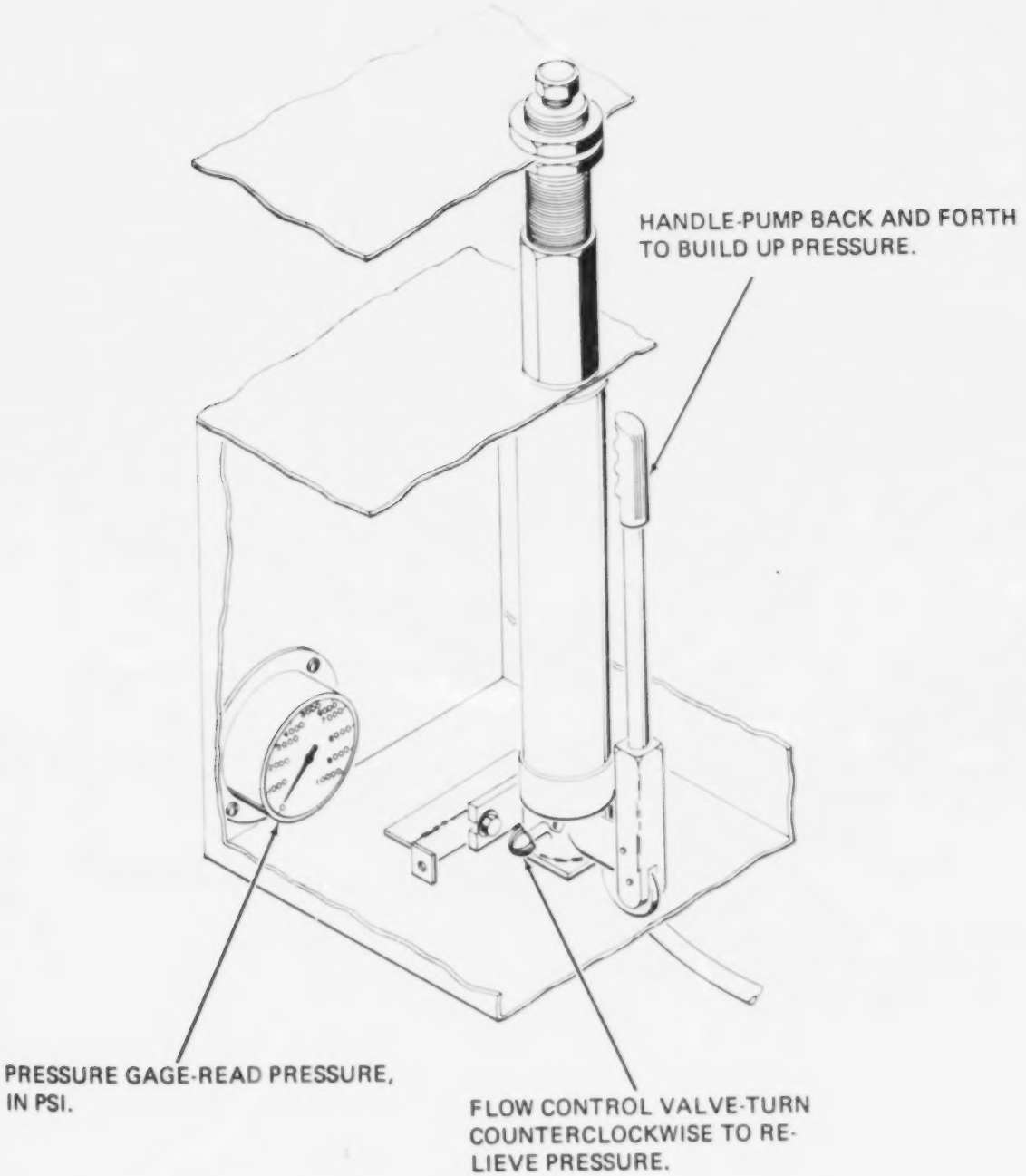

HANDLE-PUMP BACK AND FORTH TO BUILD UP PRESSURE.
PRESSURE GAGE-READ PRESSURE, IN PSI.
FLOW CONTROL VALVE-TURN COUNTERCLOCKWISE TO RELIEVE PRESSURE.

Figure 2-1. Hand Pump Flow Control Valve, Handle, and Pressure Gage.

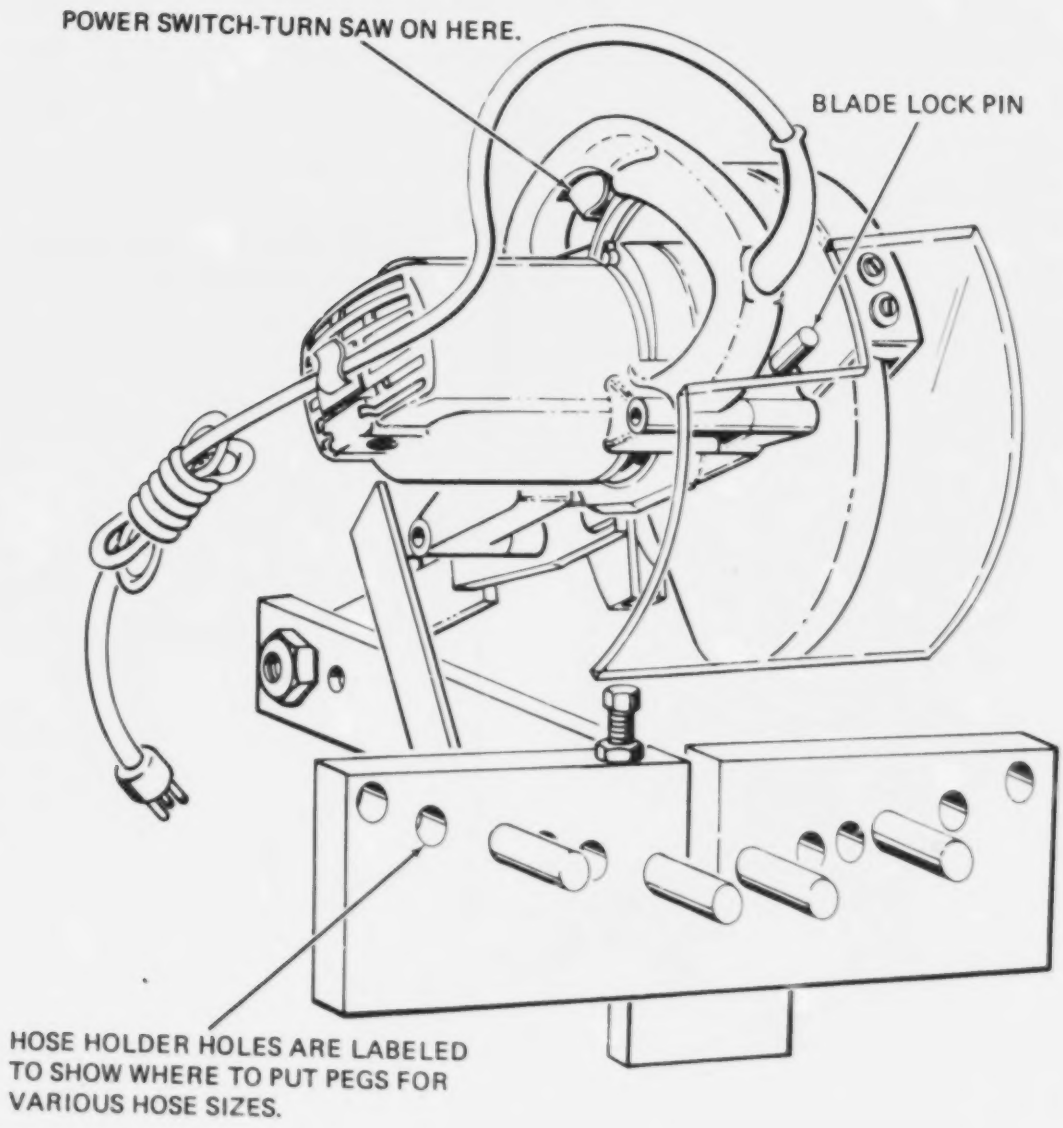

POWER SWITCH-TURN SAW ON HERE.
BLADE LOCK PIN
HOSE HOLDER HOLES ARE LABELED TO SHOW WHERE TO PUT PEGS FOR VARIOUS HOSE SIZES.

Figure 2-2. Hose Cutter Power Switch and Blade Lock Pin.

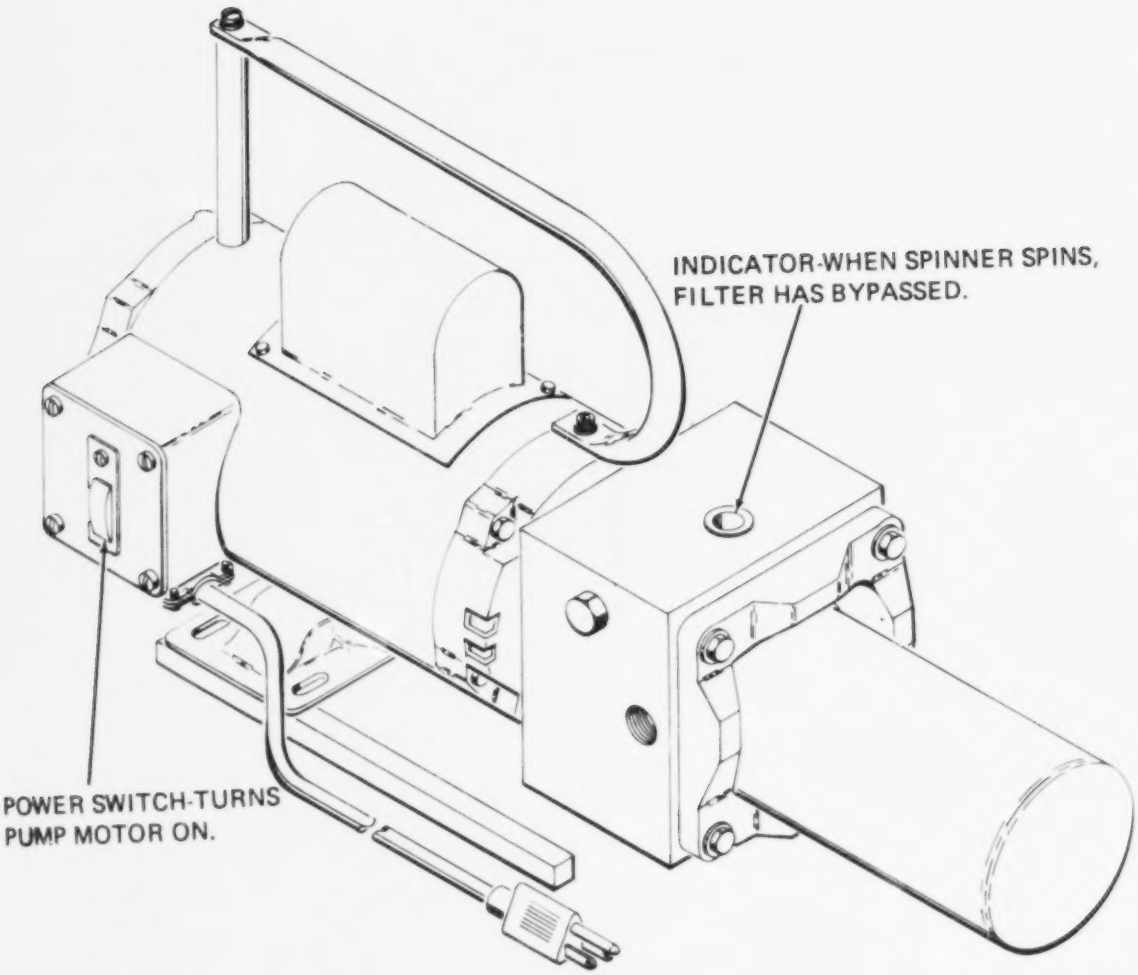


Figure 2-3. Transfer Pump Control and Indicator.

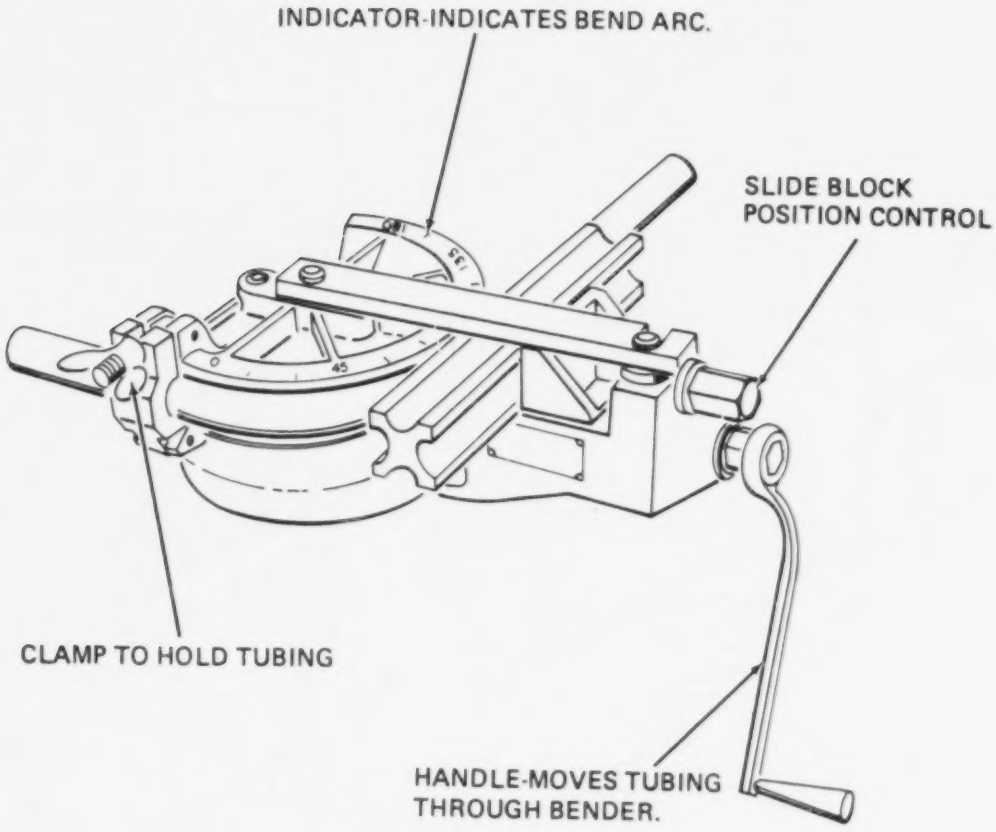


Figure 2-4. Tube Bender Controls and Indicator.

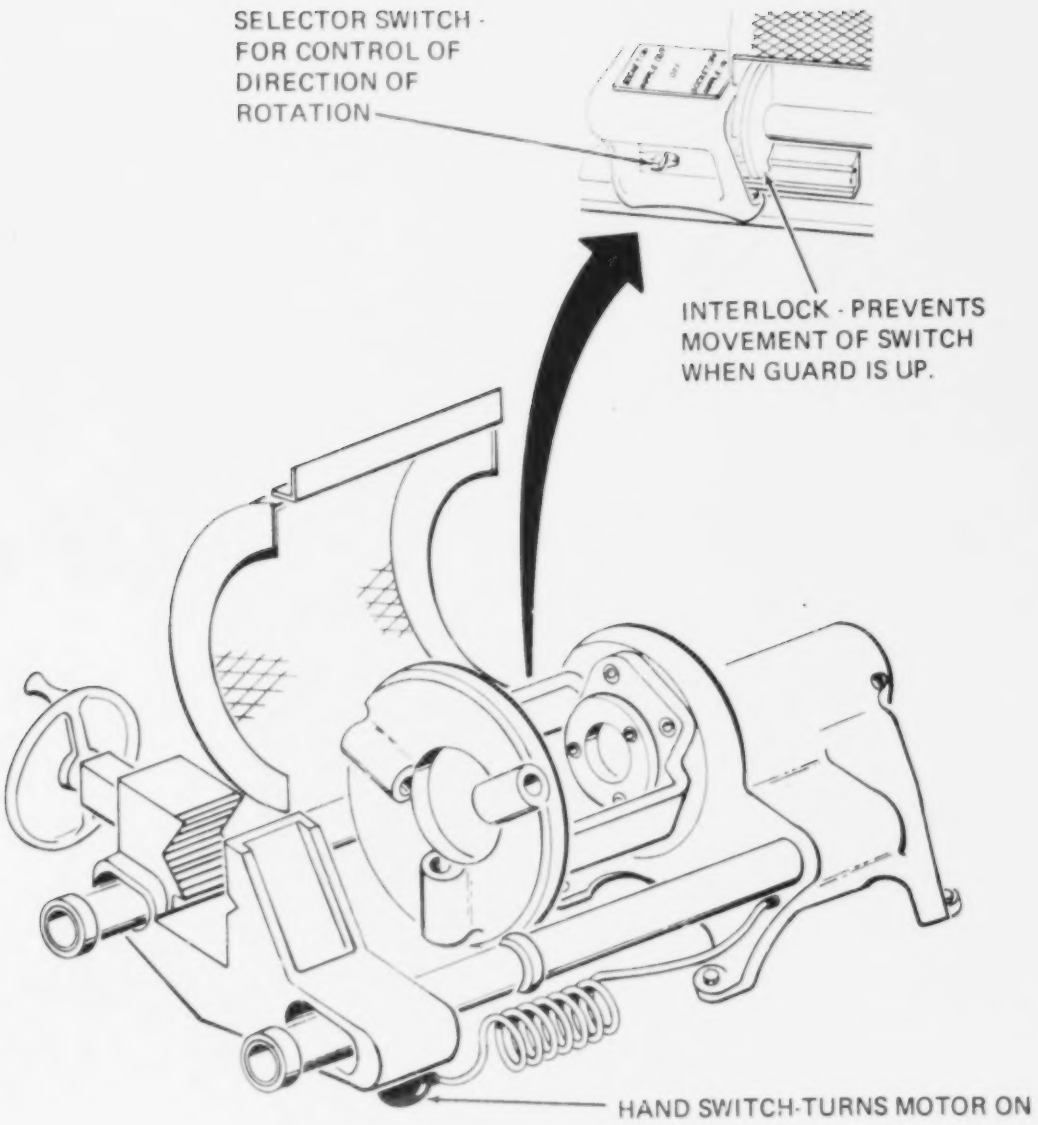

SELECTOR SWITCH - FOR CONTROL OF DIRECTION OF ROTATION
INTERLOCK - PREVENTS MOVEMENT OF SWITCH WHEN GUARD IS UP.
HAND SWITCH-TURNS MOTOR ON

Figure 2-5. Hose Coupling Assembler Controls.

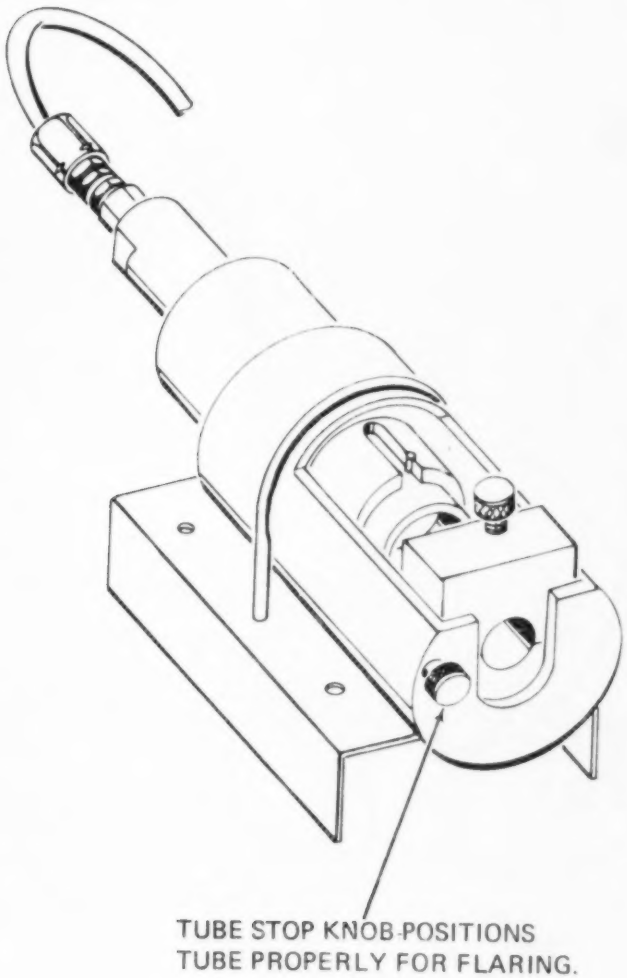


Figure 2-6. Tube Flaring Tool Tube Stop Knob.

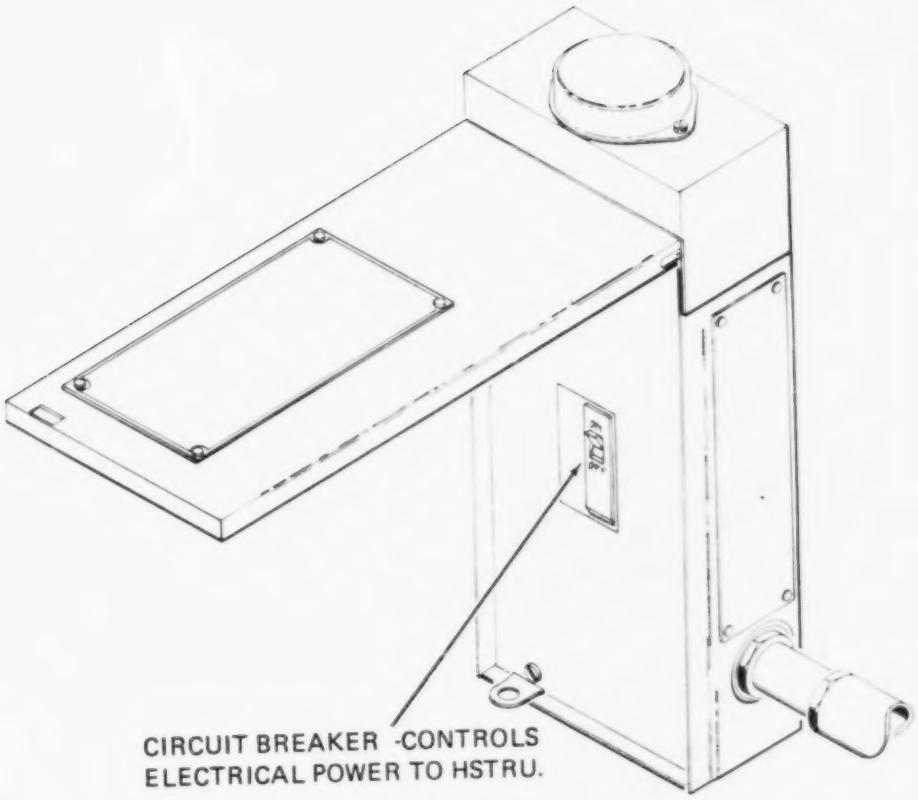
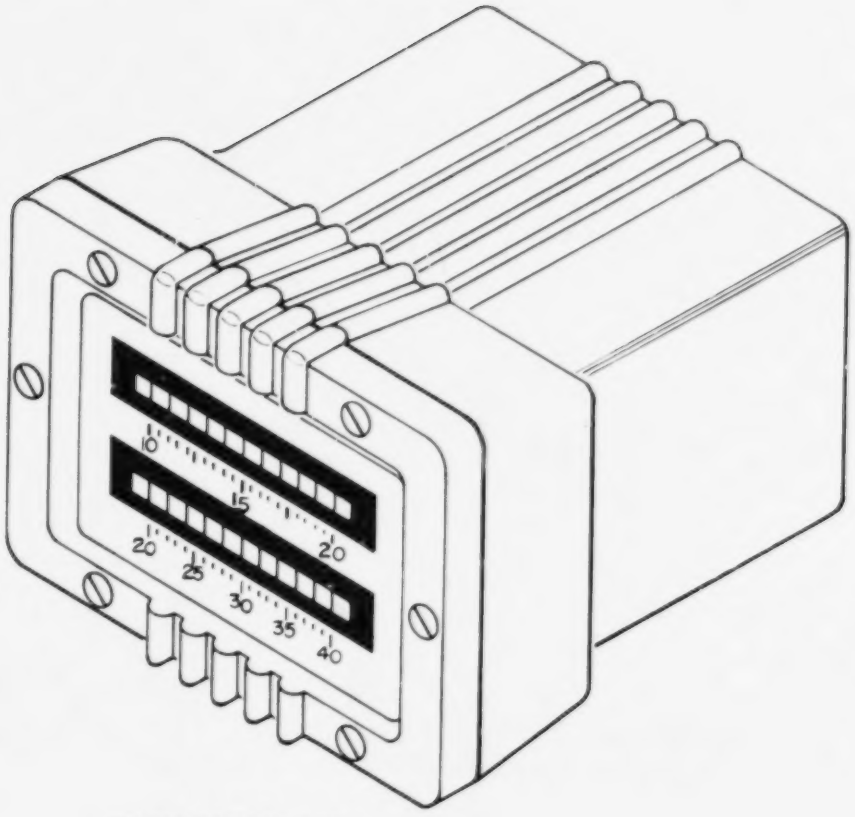


Figure 2-7. Circuit Breaker and Visual Trip Indicator. (RED)



TACHOMETER-FOR
MEASURING MOTOR RPM.

Figure 2-8. Tachometer.

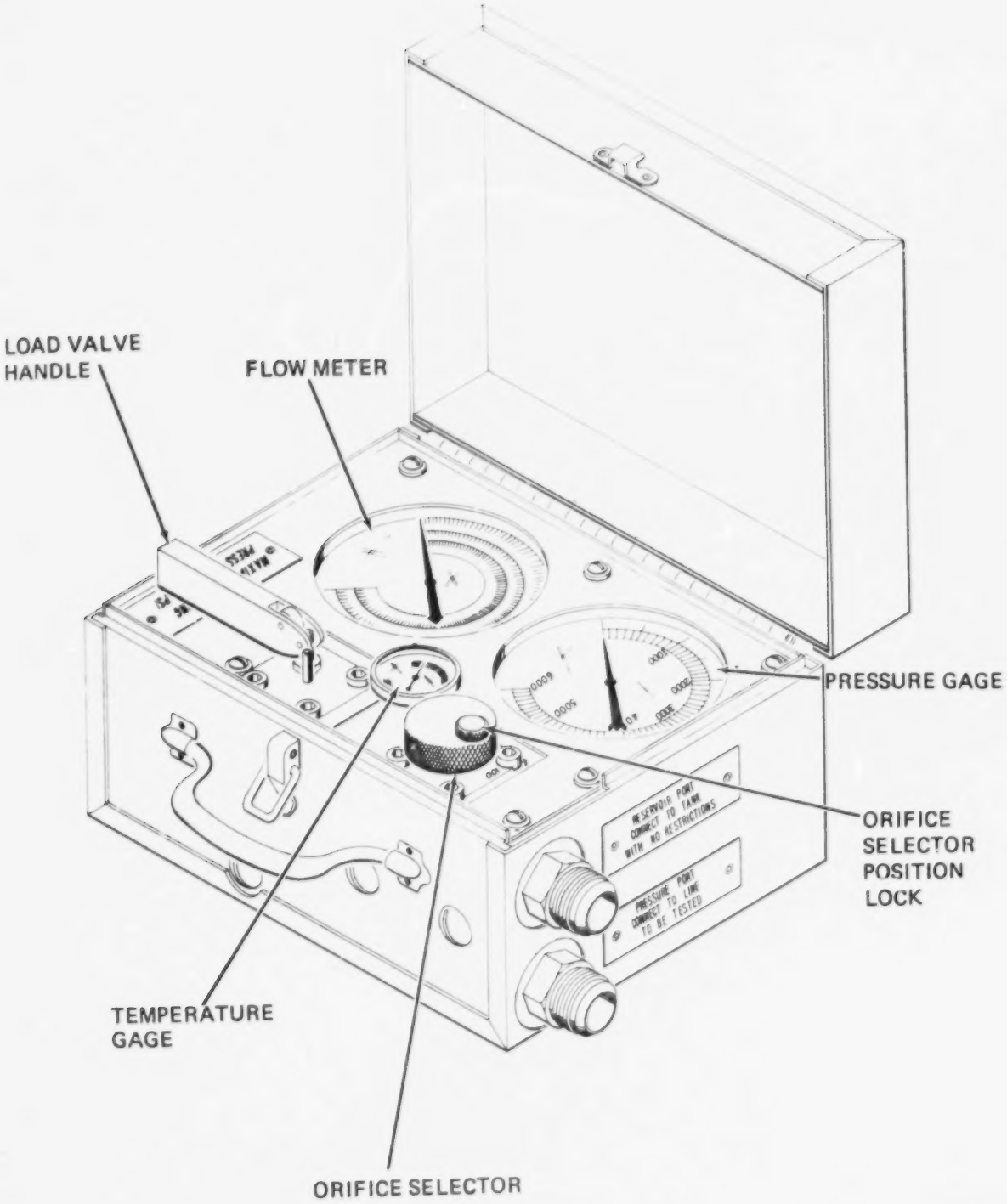


Figure 2-9. Hydraulic System Tester.

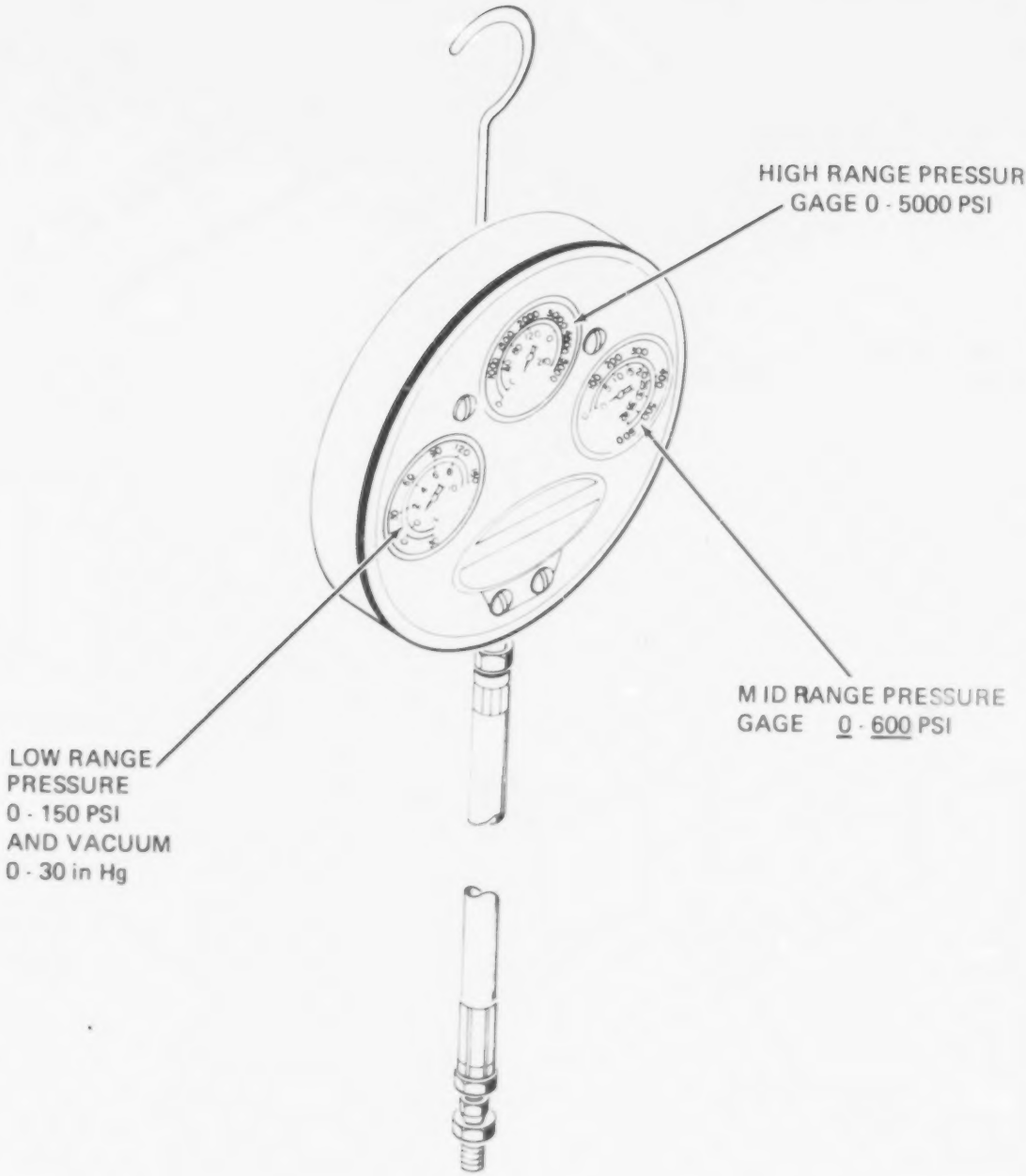


Figure 2-10. Multi-Range Pressure Gage.

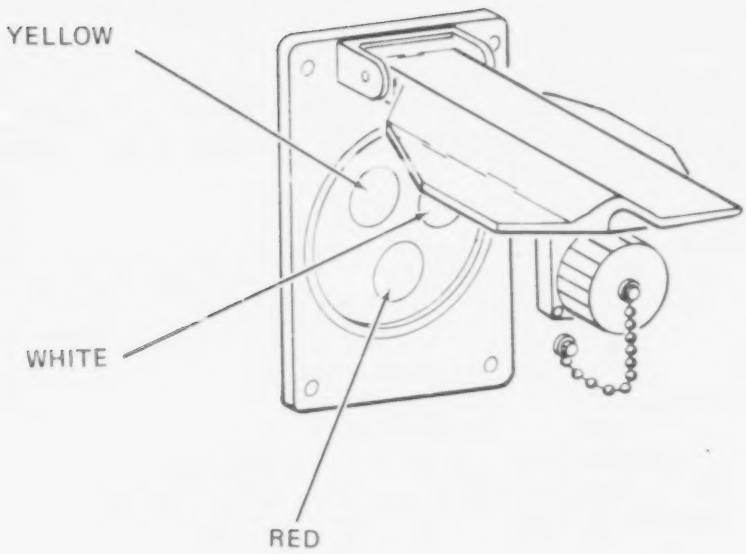


Figure 2-11. Electrical Circuit Hook-up Indicator.

SECTION III

PREVENTIVE MAINTENANCE CHECKS AND SERVICES (PMCS)

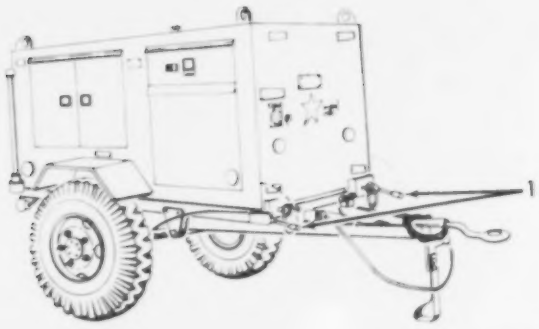
2-4. General. The following paragraphs provide general reminders regarding PMCS. PMCS procedures are provided in this section.

a. Before You Operate. Always keep in mind the WARNINGS and CAUTIONS. Perform your Before Operation (B) PMCS.

b. While You Operate. Always keep in mind the WARNINGS and CAUTIONS. Perform your During Operation (D) PMCS.

c. After You Operate. Be sure to perform your After Operation (A) PMCS.

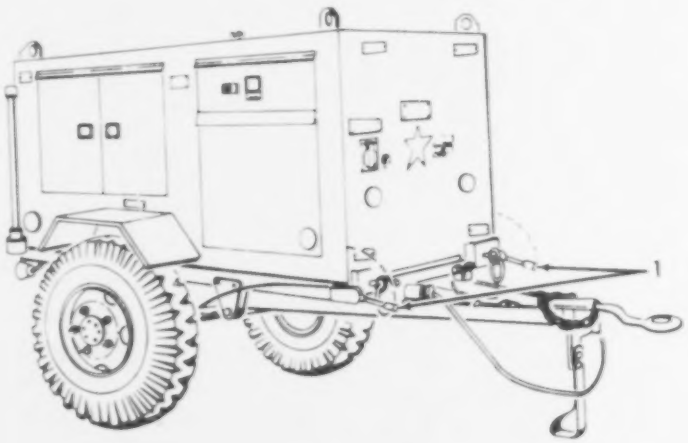
d. If Your Equipment Fails to Operate. Troubleshoot with proper equipment. Report any deficiencies using the proper forms. See TM 38-750 (TAMMS).

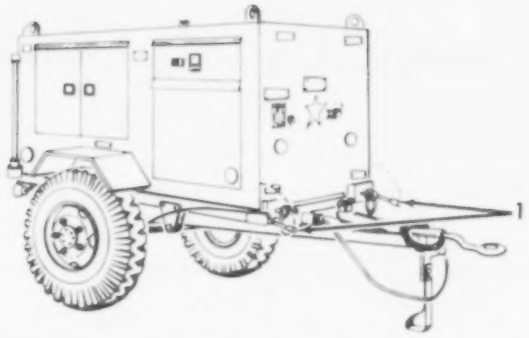


PREVENTIVE-MAINTENANCE CHECKS AND SERVICES

B-Before Operation D-During Operation A-After Operation

Item No.	INTERVAL B	INTERVAL D	INTERVAL A	ITEM TO BE INSPECTED PROCEDURE	FOR READINESS REPORTING EQPT IS NOT READY/ AVAILABLE IF:
1	•			Unhook. Rotate the mechanical parking brake handles (1) to the down position. This will engage the mechanical parking brakes. **NOTE** THE UP POSITION OF THE HANDBRAKE HANDLE RELEASES THE MECHANICAL PARKING BRAKE. THIS IS THE NORMAL POSITION FOR TOWING THE HSTRU.	

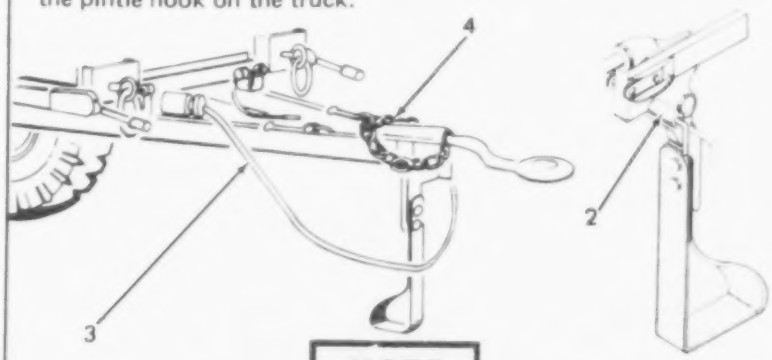


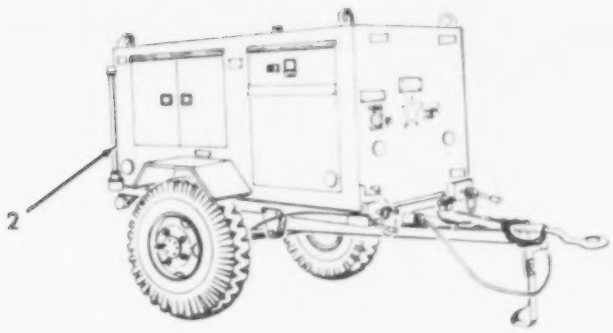


PREVENTIVE-MAINTENANCE CHECKS AND SERVICES

B-Before Operation D-During Operation A-After Operation

Item No.	INTERVAL B	D	A	ITEM TO BE INSPECTED PROCEDURE	FOR READINESS REPORTING EQPT IS NOT READY/ AVAILABLE IF:
1	•			**CAUTION** BE SURE THAT THE PIN RETURNS TO THE FULL "IN" POSITION. Pull out the pin (2) on the street side of the lunette and lower the landing gear leg. Then reinsert the pin so that the leg is locked in the vertical position. Disconnect the brake light and turn signal cable (3). Unhook the safety chains (4). Be sure that the HSTRU power cable is disconnected. Then unhook the pintle hook on the truck. **NOTE** IF THE HSTRU IS CONNECTED TO A CONTACT MAINTENANCE TRUCK AND WILL NOT BE UNHOOKED, THE HANDBRAKE AND THE LANDING GEAR LEG SHOULD BE OPERATED MONTHLY TO BE SURE THAT THEY ARE OPERABLE.	

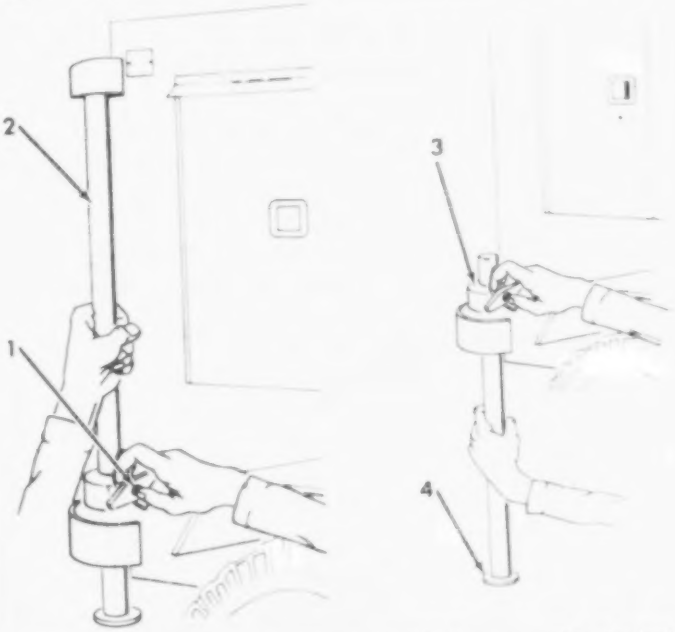




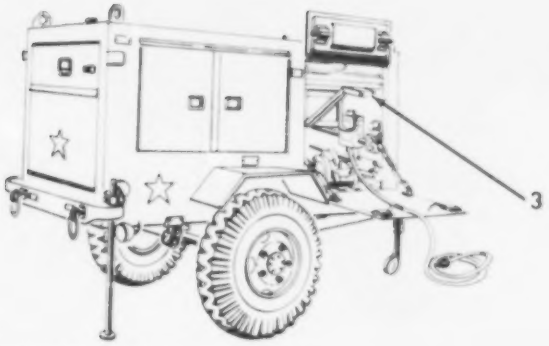
PREVENTIVE-MAINTENANCE CHECKS AND SERVICES

B-Before Operation D-During Operation A-After Operation

Item No.	INTERVAL B	INTERVAL D	INTERVAL A	ITEM TO BE INSPECTED / PROCEDURE	FOR READINESS REPORTING EQPT IS NOT READY/ AVAILABLE IF:
2	●			Deploy Stabilizer Leg. Remove the pin (1) from the stabilizer leg (2) by pressing the release button and pulling the pin out.	



Permit the leg (2) to slide down until it lines up with the hole. After the leg (2) contacts the ground, reinstall the pin (1) in the bracket (3). This will prevent the guide leg from collapsing as weight is placed on it. Screw the foot (4) downward to contact the ground, if adjustment is necessary.



PREVENTIVE-MAINTENANCE CHECKS AND SERVICES

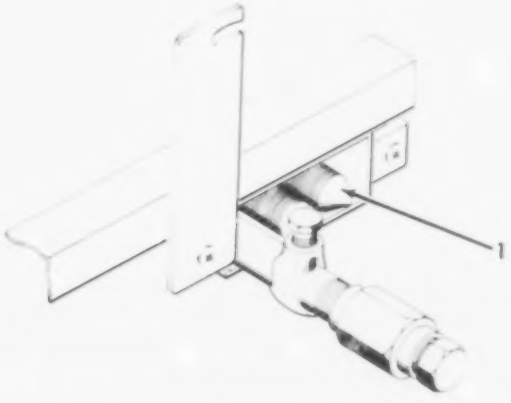
B-Before Operation D-During Operation A-After Operation

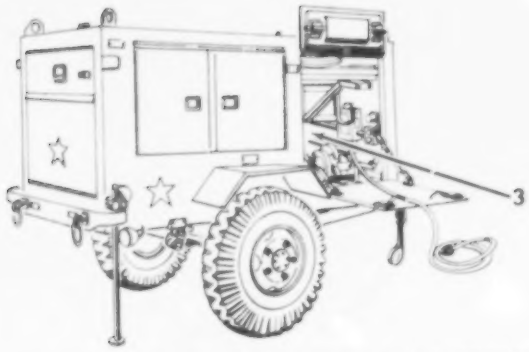
Item No.	INTERVAL B	D	A	ITEM TO BE INSPECTED PROCEDURE	FOR READINESS REPORTING EQPT IS NOT READY/ AVAILABLE IF:
3	●			Grounding and Fire Extinguisher Deployment.	

WARNING

BE SURE YOU CONNECT THE GROUND WIRE TO THE HSTRU BEFORE YOU CONNECT IT TO THE GROUND STAKE. THIS WILL CAUSE ANY POTENTIAL ARCING TO OCCUR AWAY FROM THE HSTRU.

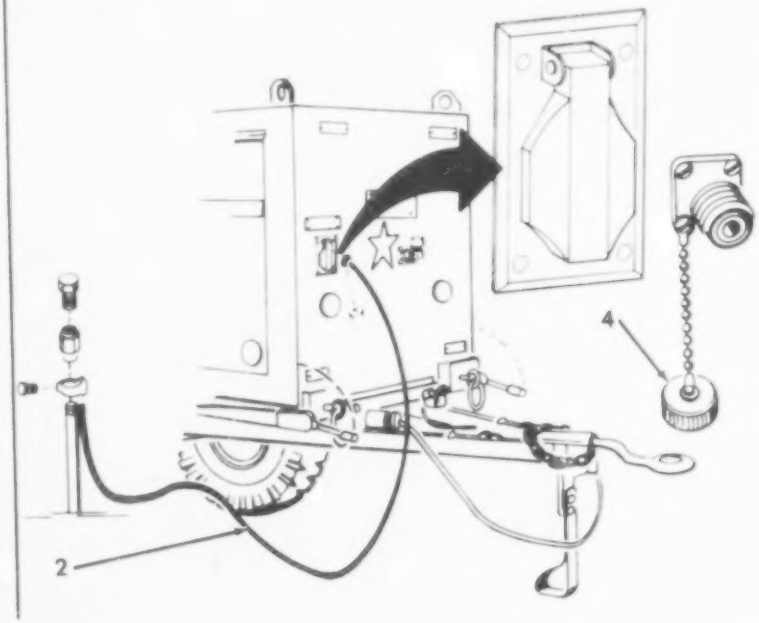
If electrical power is to be applied to the HSTRU and a prepared earth ground is not available, remove the pieces of the ground stake (1) from the compartment. Drive the ground stake (1) into the ground near the HSTRU to its full depth.

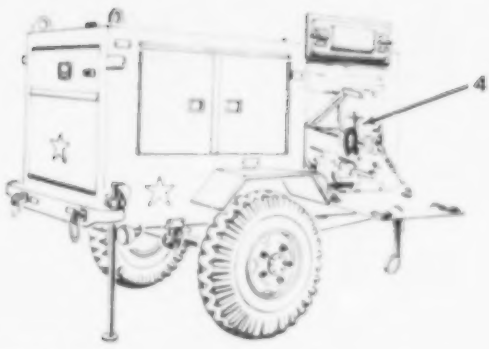




PREVENTIVE-MAINTENANCE CHECKS AND SERVICES

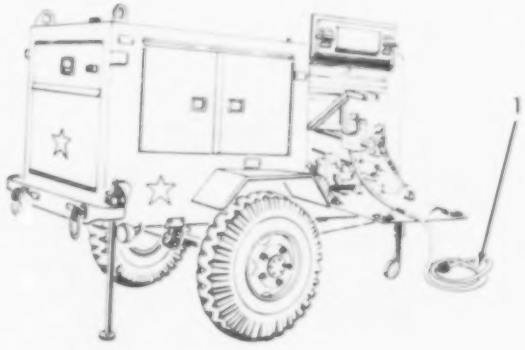
B-Before Operation D-During Operation A-After Operation

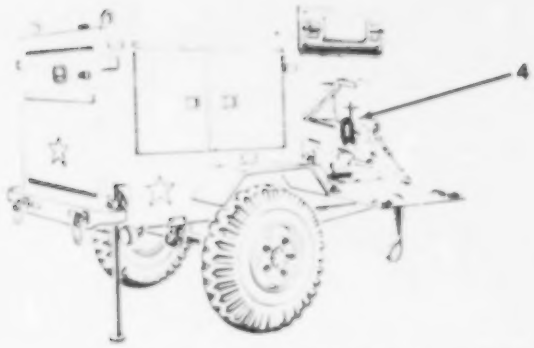
Item No.	INTERVAL B	D	A	ITEM TO BE INSPECTED PROCEDURE	FOR READINESS REPORTING EQPT IS NOT READY/ AVAILABLE IF:
3	•			Remove the cap (4) from the HSTRU ground connection. Connect the ground wire (2) to the HSTRU and connect the other end of the ground wire to the ground stake as shown. Remove fire extinguisher and place within reach of the HSTRU. Fire extinguisher is mounted on the floor in forward curb side compartment as shown (3). 	



PREVENTIVE-MAINTENANCE CHECKS AND SERVICES

B-Before Operation D-During Operation A-After Operation

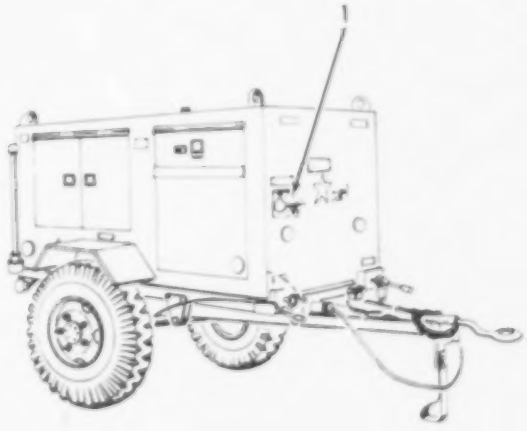
Item No.	INTERVAL B	D	A	ITEM TO BE INSPECTED PROCEDURE	FOR READINESS REPORTING EQPT IS NOT READY/ AVAILABLE IF:
4	•			External Power Application **WARNING** WHEN USING A 5KW GENERATOR FOR ELECTRICAL POWER, PLACE THE GENERATOR A MINIMUM OF 15 YARDS AWAY FROM THE HSTRU TO REDUCE THE NOISE LEVEL AT THE HSTRU. MAKE SURE THE HSTRU AND THE EXTERNAL POWER SOURCE ARE PROPERLY GROUNDED PRIOR TO APPLYING EXTERNAL POWER. Remove the external power supply cable (1) from the forward curb side compartment. 	

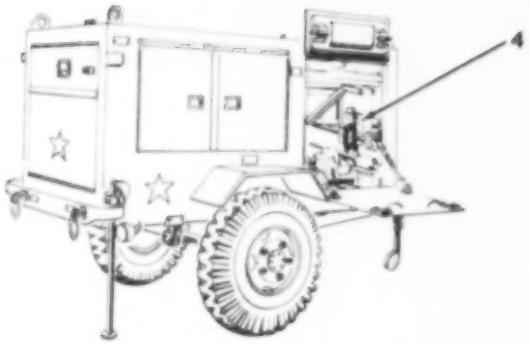


PREVENTIVE MAINTENANCE CHECKS AND SERVICES

B-Before Operation D-During Operation A-After Operation

Item No.	INTERVAL B	D	A	ITEM TO BE INSPECTED PROCEDURE	FOR READINESS REPORTING EQPT IS NOT READY/ AVAILABLE IF:
4	•			**WARNING** IF THE RED LIGHT COMES ON IN THE NEXT STEP, UNPLUG THE HSTRU IMMEDIATELY. Lift cap on indicator (1). Plug the cable into a source of 120 V 60 Hz electrical power. Check the indicator lights. Both the white and yellow lights should be on. If the red light comes on, or only the white, or only the yellow, disconnect immediately.	

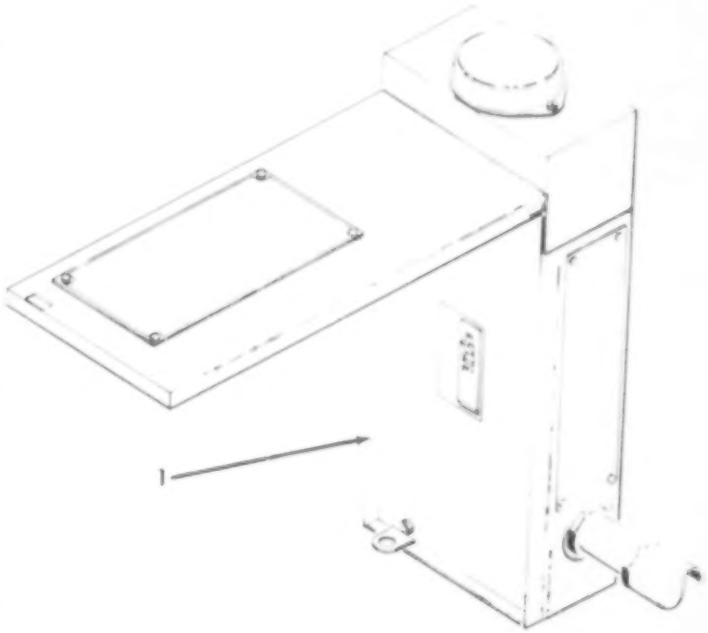


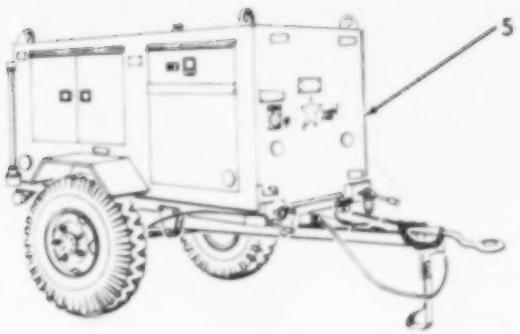


PREVENTIVE-MAINTENANCE CHECKS AND SERVICES

B-Before Operation D-During Operation A-After Operation

Item No.	INTERVAL B	D	A	ITEM TO BE INSPECTED PROCEDURE	FOR READINESS REPORTING EQPT IS NOT READY/ AVAILABLE IF:
4	•			Open the main power panel box (1). Turn on the circuit breaker. Be sure the circuit breaker clicks to the on position. If it will not click or if it returns to the tripped position, troubleshoot in accordance with paragraph 3-8.	

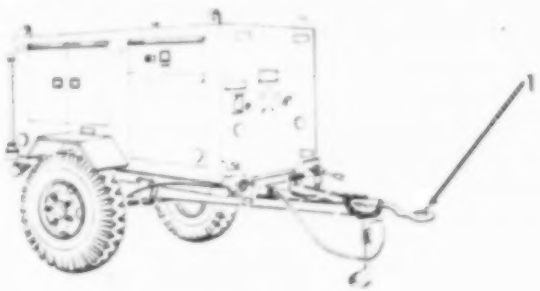


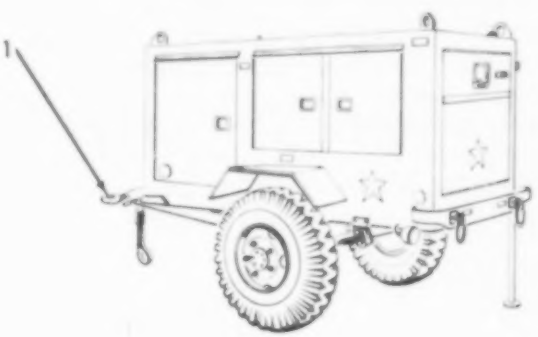


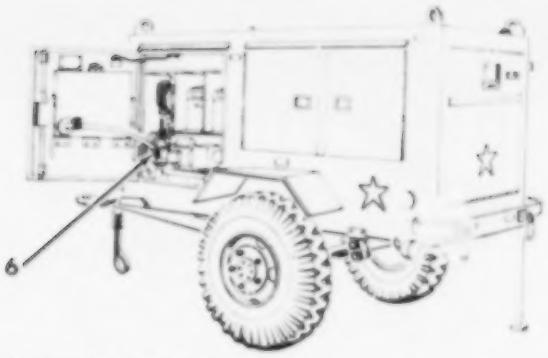
PREVENTIVE MAINTENANCE CHECKS AND SERVICES

B-Before Operation D-During Operation A-After Operation

Item No.	INTERVAL B	D	A	ITEM TO BE INSPECTED PROCEDURE	FOR READINESS REPORTING EQPT IS NOT READY/ AVAILABLE IF:
5	•			Inspect. Before placing the HSTRU in operation, inspect external parts of the trailer for rust, corrosion, dents, skin cracks, or missing rivets, broken or damaged door latches, missing or cracked reflectors, damaged lunette eye (1) and work around the trailer in a clockwise fashion.	



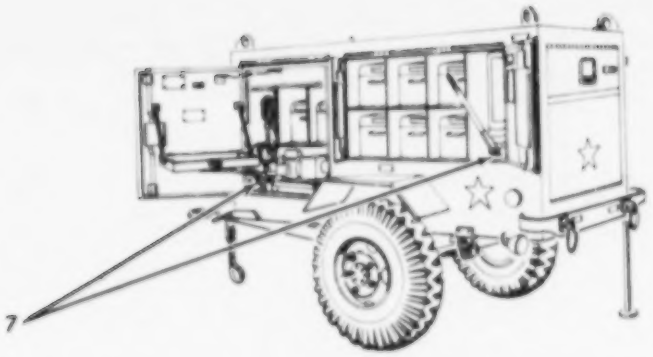




PREVENTIVE-MAINTENANCE CHECKS AND SERVICES

B-Before Operation D-During Operation A-After Operation

Item No.	INTERVAL B	INTERVAL D	INTERVAL A	ITEM TO BE INSPECTED PROCEDURE	FOR READINESS REPORTING EQPT IS NOT READY/ AVAILABLE IF:
6	•	•	•	Inspect for leaks. **WARNING** IF THE HSTRU IS USED IN AN ENCLOSED AREA, BE SURE TO PROVIDE PROPER VENTILATION. **CAUTION** DO NOT APPLY PRESSURE TO A TOOL OR COMPONENT SUSPECTED OF LEAKING EXCEPT IN ACCORDANCE WITH PROPER TROUBLESHOOTING PROCEDURES. **NOTE** IF THE HSTRU IS BEING USED INSIDE A BUILDING, BE SURE TO SOAK UP ANY SPILLS ON THE FLOOR WITH SAND, OR OTHER OIL ABSORBING MATERIAL. Visually inspect the HSTRU proof pressure and solvent wash system for evidence of leaks. Using a clean, lint-free rag, wipe down any accumulated hydraulic fluid on the exterior of components. Carefully note any continued leakage.	



PREVENTIVE-MAINTENANCE CHECKS AND SERVICES

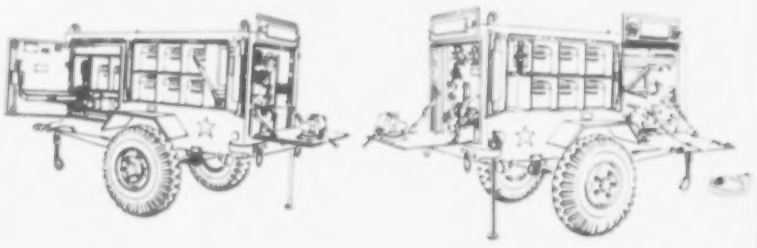
B-Before Operation D-During Operation A-After Operation

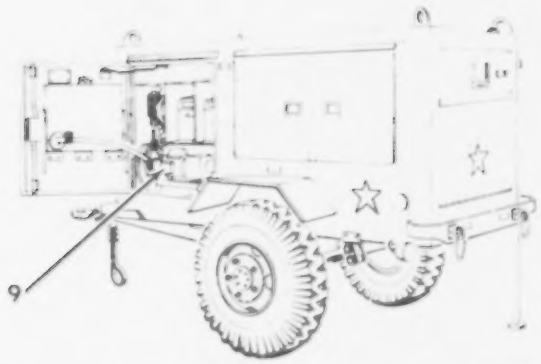
Item No.	INTERVAL B	INTERVAL D	INTERVAL A	ITEM TO BE INSPECTED PROCEDURE	FOR READINESS REPORTING EQPT IS NOT READY/ AVAILABLE IF:
7	•	•	•	Inspect for Hydraulic Leaks. During the operation of the HSTRU, reservoirs, pumps, filters, lines, hoses, fittings, tools, and components should be checked for leaks. **NOTE** RESIDUE FROM SEEPAGE SHOULD BE WIPED UP WITH A CLEAN, LINT-FREE RAG. Carefully notice any evidence of leakage. In situations where leaked fluid has run, trace the leak back to its source. Pay particular attention to hose, tube, and component fittings, couplings, and connectors as locations of leaks. **CAUTION** DO NOT OVER-TORQUE HYDRAULIC FITTINGS. In the case of leaks around clamps, connectors, couplings, and/ or fittings, insure that they are properly torqued.	

PREVENTIVE-MAINTENANCE CHECKS AND SERVICES

B-Before Operation D-During Operation A-After Operation

Item No.	INTERVAL B	INTERVAL D	INTERVAL A	ITEM TO BE INSPECTED PROCEDURE	FOR READINESS REPORTING EQPT IS NOT READY/ AVAILABLE IF:
8	●		●	Inspect for Foreign Object Damage (FOD) or Potential FOD. Open the doors and visually inspect the HSTRU for evidence of foreign object damage or situations which might potentially cause FOD. Examples of this are, large burrs, or sharp objects left where tires might be punctured by them; tools or bits of hardware which might jam door latches; etc. **NOTE** ITEM 12 MAY BE PERFORMED AT THE SAME TIME AS THIS ITEM. MANY UNLIKELY OBJECTS SUCH AS RAGS AND PAPER CAN BE EITHER DIRECT OR INDIRECT CAUSES OF FOD. BE SURE TO PROPERLY DISPOSE OF UNDESIRABLE FOREIGN OBJECTS. Begin your FOD inspection at the front of the HSTRU and proceed in a clockwise direction. Be sure to check all compartments thoroughly.	

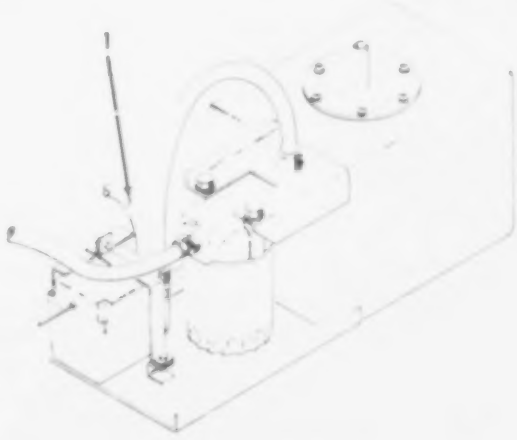




PREVENTIVE-MAINTENANCE CHECKS AND SERVICES

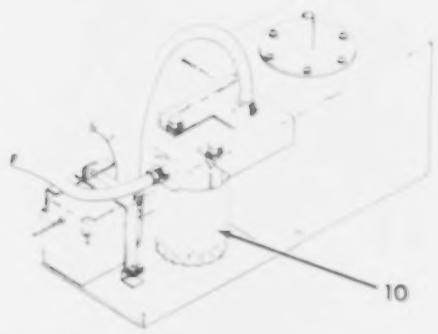
B-Before Operation D-During Operation A-After Operation

Item No.	INTERVAL B	D	A	ITEM TO BE INSPECTED PROCEDURE	FOR READINESS REPORTING EQPT IS NOT READY/ AVAILABLE IF:
9	•			Service Solvent Wash Reservoir. Check fluid level in clear plastic tube (1). If it is more than two inches below the top of the tank add solvent as necessary by pouring it in the wash tray.	



NOTE

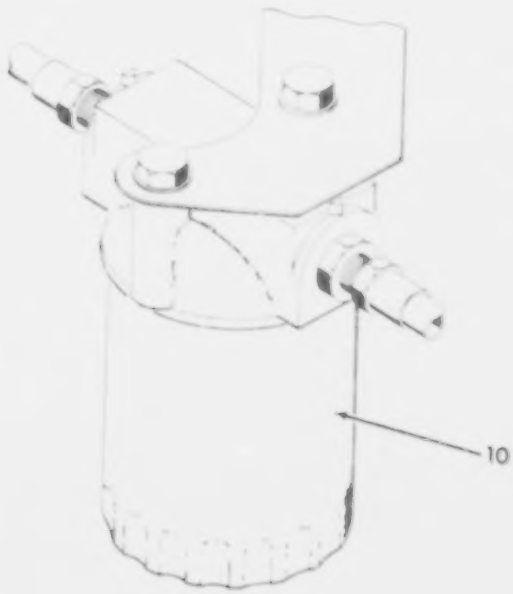
THE HSTRU MUST BE PARKED ON LEVEL GROUND OR WITH THE TONGUE ON DOWNSLOPE FOR PROPER SOLVENT DRAINAGE ON WASH TRAY.

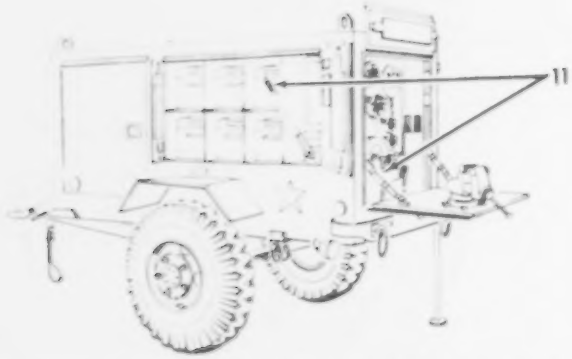


PREVENTIVE-MAINTENANCE CHECKS AND SERVICES

B-Before Operation D-During Operation A-After Operation

Item No.	INTERVAL B	D	A	ITEM TO BE INSPECTED PROCEDURE	FOR READINESS REPORTING EQPT IS NOT READY/ AVAILABLE IF:
10	•	•	•	Test. Turn the pump on and check the flow. Replace the filter element if the flow is restricted.	

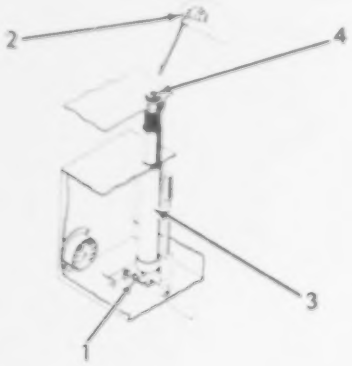


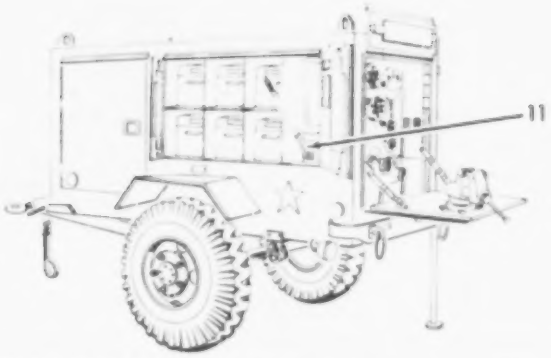


PREVENTIVE-MAINTENANCE CHECKS AND SERVICES

B-Before Operation D-During Operation A-After Operation

Item No.	INTERVAL B	D	A	ITEM TO BE INSPECTED PROCEDURE	FOR READINESS REPORTING EQPT IS NOT READY/ AVAILABLE IF:
11	•			Proof Pressure System and Tube Flaring Tool. **WARNING** BE SURE NO ONE IS AT OR NEAR THE REAR OF THE HSTRU PRIOR TO APPLYING PRESSURE. **CAUTION** BEFORE PRESSURE TESTING OR USING THE HAND PUMP, BE SURE THAT THE RESERVOIR IS PROPERLY SERVICED. Open the bypass valve (1) by turning it counterclockwise. Remove the cap (2) from the hand pump (3) filler port (4) and check the dipstick. Add fluid (OE10) as required.	

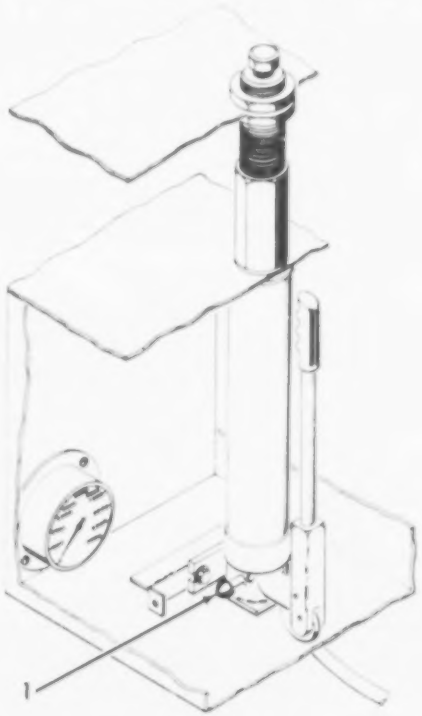


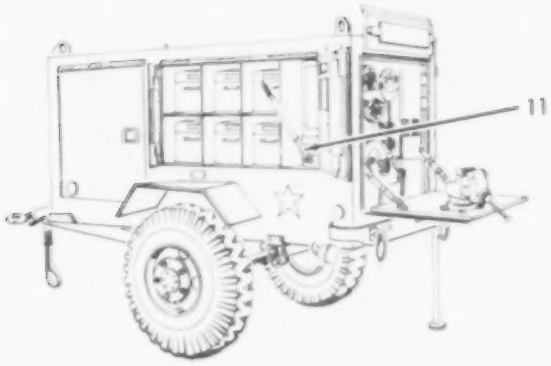


PREVENTIVE-MAINTENANCE CHECKS AND SERVICES

B-Before Operation D-During Operation A-After Operation

Item No.	INTERVAL B	D	A	ITEM TO BE INSPECTED PROCEDURE	FOR READINESS REPORTING EQPT IS NOT READY/ AVAILABLE IF:
11	●			After the reservoir is properly serviced, close the valve (1) by turning it clockwise as far as it will go finger tight, do not force.	

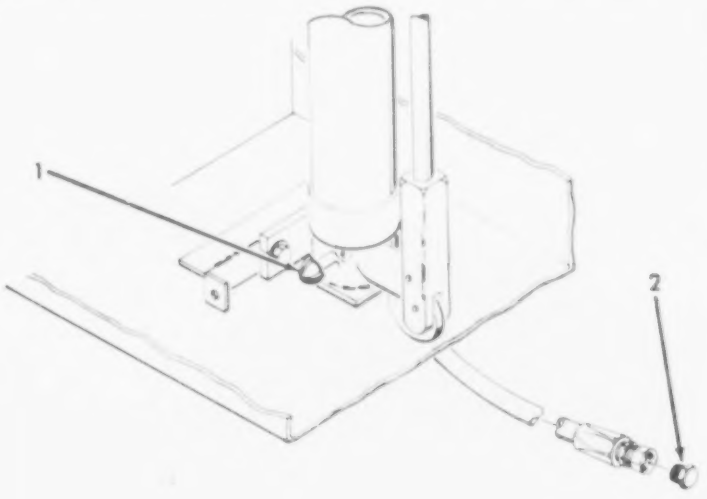


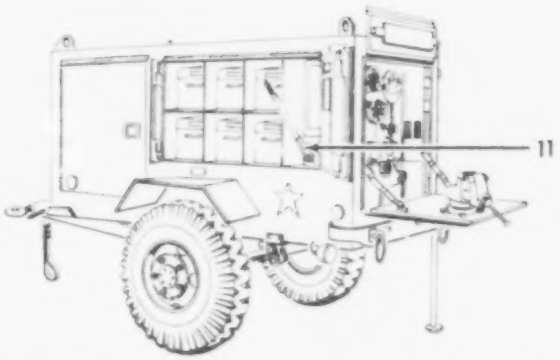


PREVENTIVE MAINTENANCE CHECKS AND SERVICES

B-Before Operation D-During Operation A-After Operation

Item No.	INTERVAL B	D	A	ITEM TO BE INSPECTED / PROCEDURE	FOR READINESS REPORTING EQPT IS NOT READY/ AVAILABLE IF:
11	●			Insert plug (2) into the line finger tight. Pump until fluid starts to seep, indicating that the air is out of the line. Tighten the plug and pump to 5000 PSI. **NOTE** IF PRESSURE DROPS OFF, LOOK FOR LEAKS. Open the valve (1) by turning it counterclockwise as soon as you are satisfied that the hand pump is operating correctly.	

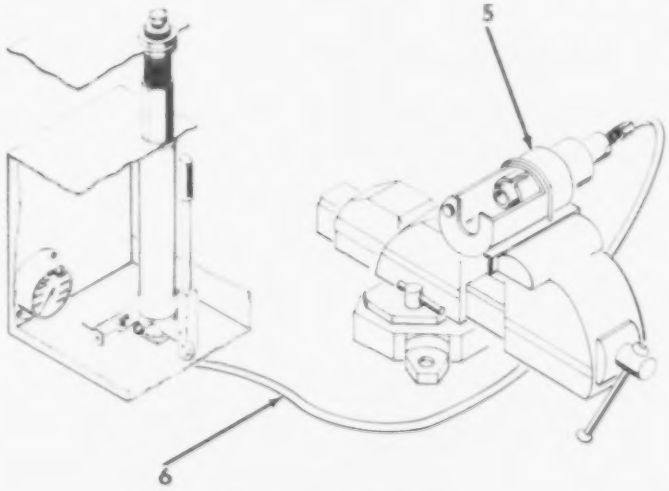




PREVENTIVE-MAINTENANCE CHECKS AND SERVICES

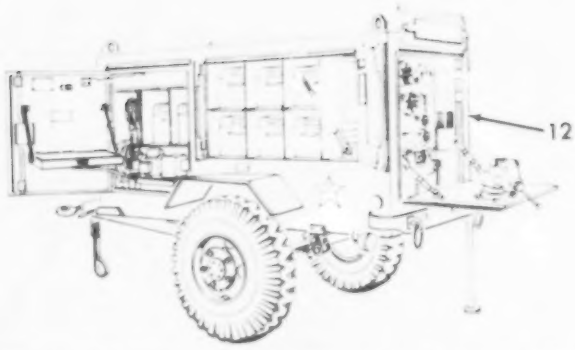
B-Before Operation D-During Operation A-After Operation

Item No.	INTERVAL B	D	A	ITEM TO BE INSPECTED PROCEDURE	FOR READINESS REPORTING EQPT IS NOT READY/ AVAILABLE IF:
11	●			Place the tube flaring tool (5) in the vise. Connect the hand pump hose (6) to the tool. Bleed air out of system. Extend ram one inch by pumping hand pump.	



CAUTION

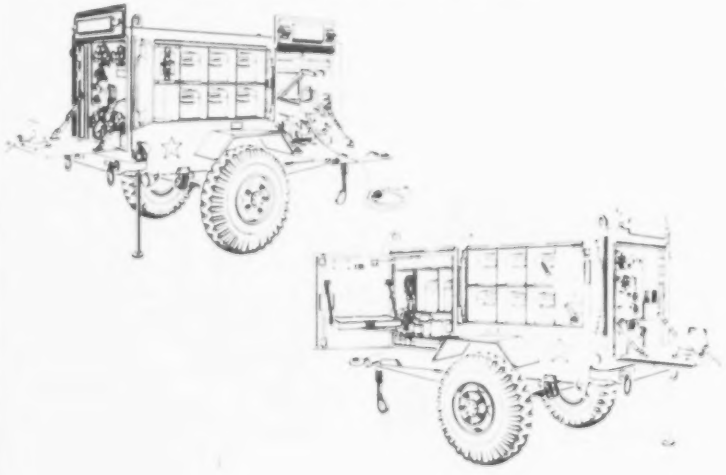
DO NOT OVEREXTEND RAM OR YOU WILL BREAK THE FLARING TOOL.

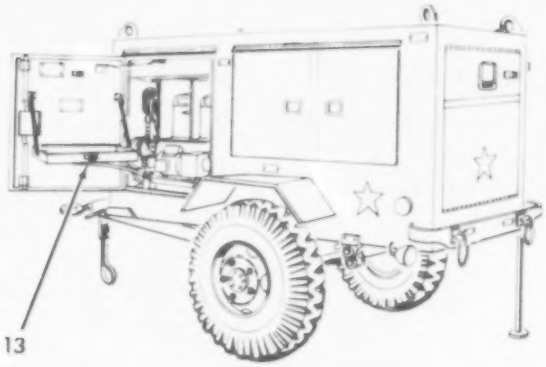


PREVENTIVE-MAINTENANCE CHECKS AND SERVICES

B-Before Operation D-During Operation A-After Operation

Item No.	INTERVAL B	D	A	ITEM TO BE INSPECTED PROCEDURE	FOR READINESS REPORTING EQPT IS NOT READY/ AVAILABLE IF:
12	●			Inspect. Prior to placing the HSTRU in operation, conduct a systematic compartment-by-compartment inspection of the interior of the HSTRU. Look for rust, corrosion, dents, skin cracks, popped or missing rivets, evidence of hydraulic leaks, worn or damaged electrical wiring, damaged or missing tools or test equipment, clogged drains, hydraulic system fittings tightness, etc. Correct deficiencies. **NOTE** THIS INSPECTION MAY BE CONDUCTED IN CONJUNCTION WITH ITEM NO. 8, FOD INSPECTION.	

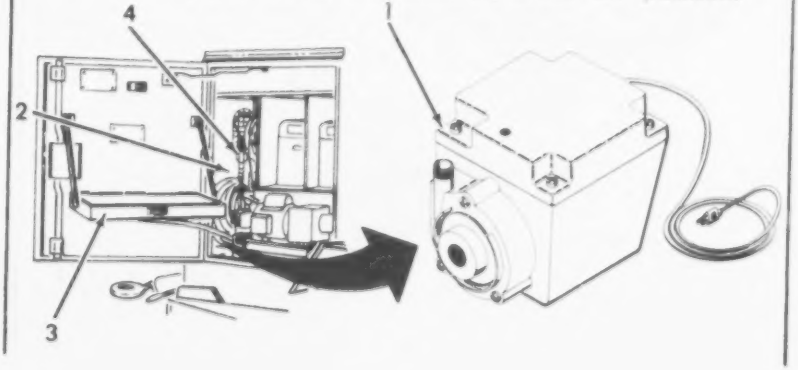


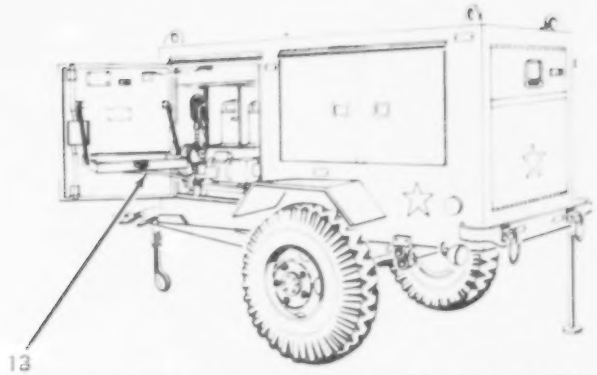


PREVENTIVE-MAINTENANCE CHECKS AND SERVICES

B-Before Operation D-During Operation A-After Operation

Item No.	INTERVAL B	D	A	ITEM TO BE INSPECTED / PROCEDURE	FOR READINESS REPORTING EQPT IS NOT READY/ AVAILABLE IF:
13	●			Operation Check of Solvent Wash System & Drop Light. **WARNING** BEFORE APPLYING POWER, BE SURE THE HSTRU IS PROPERLY GROUNDED (SEE PMCS 3). **CAUTION** BEFORE OPERATING HYDRAULICALLY OPERATED TOOLS, BE SURE THE RESERVOIR(S) ARE PROPERLY SERVICED (SEE PMCS 9, 10, and 11). Apply power to the HSTRU (See PMCS 3 & 4). Plug the solvent circulating pump (1) into the electrical outlet (2). Fold down the wash tray (3). Position the switch (4) to the "on" position.	

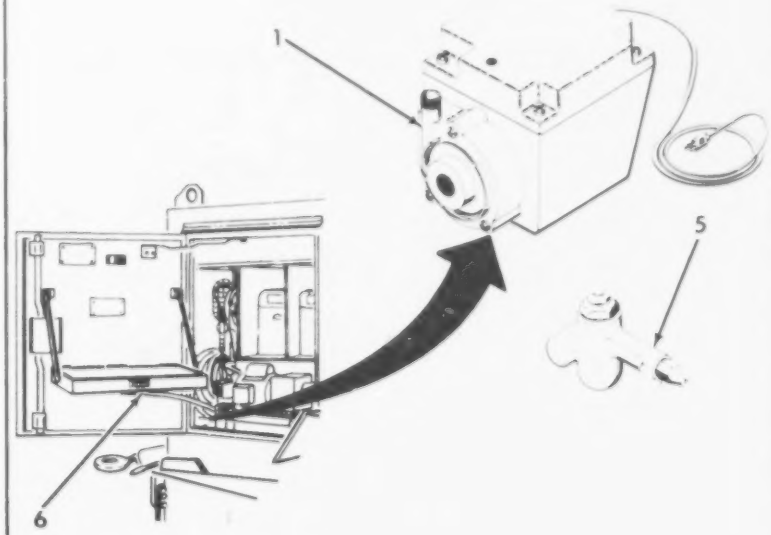


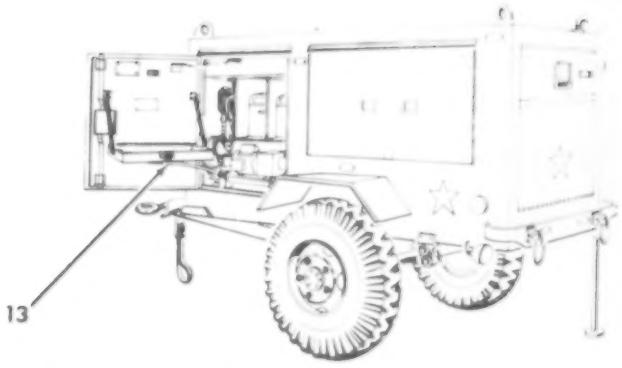


PREVENTIVE-MAINTENANCE CHECKS AND SERVICES

B-Before Operation D-During Operation A-After Operation

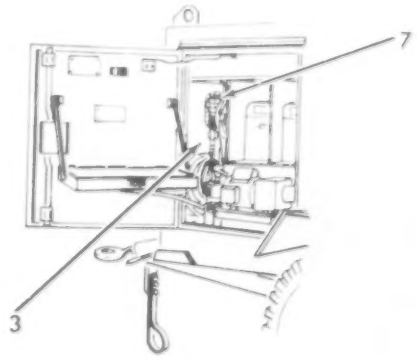
Item No.	INTERVAL B	D	A	ITEM TO BE INSPECTED PROCEDURE	FOR READINESS REPORTING EQPT IS NOT READY/ AVAILABLE IF:
13	•			**NOTE** BE SURE THE WASH TRAY DRAIN LINE (6) IS SECURELY IN PLACE. Discharge solvent fluid from the nozzle (5). If low flow rate - check filter, pump, line restrictions, plugged nozzle.	

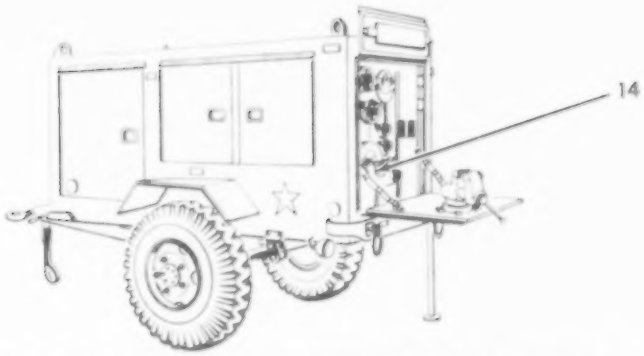




PREVENTIVE-MAINTENANCE CHECKS AND SERVICES

B-Before Operation D-During Operation A-After Operation

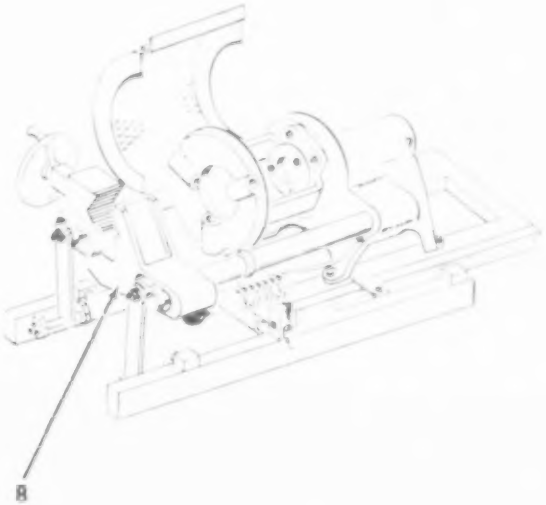
Item No.	INTERVAL B	D	A	ITEM TO BE INSPECTED PROCEDURE	FOR READINESS REPORTING EQPT IS NOT READY/ AVAILABLE IF:
13	●			Plug in the drop light (7). Switch it on and note if it works. Replace bulb if inoperable. Turn the drop light off and unplug it. Clean out the wash tray with a clean, lint-free rag. Clean any debris off the drain strainer. Fold up the wash tray and secure it. Turn switch (3) to the off position and unplug the pump. Secure washing nozzle. **CAUTION** MAKE SURE HOSES, NOZZLE, AND WIRES ARE CLEAR OF DOOR. Close this compartment.  	

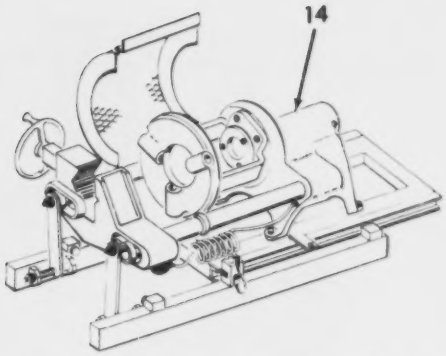


PREVENTIVE-MAINTENANCE CHECKS AND SERVICES

B-Before Operation D-During Operation A-After Operation

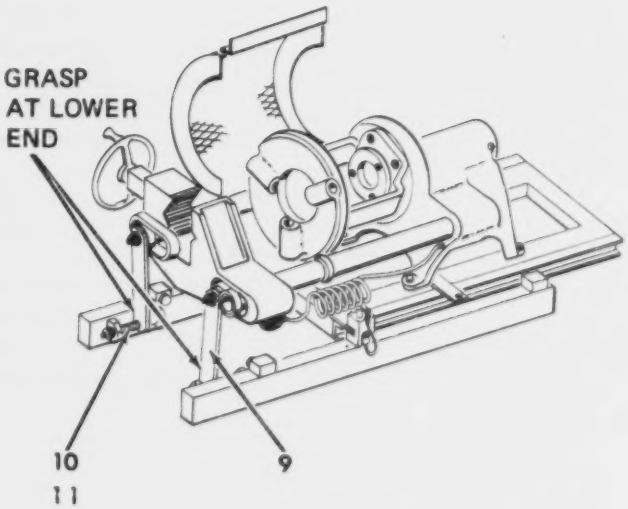
Item No.	INTERVAL B	D	A	ITEM TO BE INSPECTED PROCEDURE	FOR READINESS REPORTING EQPT IS NOT READY/ AVAILABLE IF:
14	●			Operation Check of Hose Coupling Assembler. Check the hose coupling assembler (8). Start by sliding the tool out to the operating position.	





PREVENTIVE-MAINTENANCE CHECKS AND SERVICES

B-Before Operation D-During Operation A-After Operation

Item No.	INTERVAL B	D	A	ITEM TO BE INSPECTED PROCEDURE	FOR READINESS REPORTING EQPT IS NOT READY/ AVAILABLE IF:
14	●			 To do this, grasp the retaining brackets (9) near the bottom and firmly pull them toward the rear of the trailer. Slide them along the guide arms (10) until the springs (11) are compressed. Rotate the retaining brackets down and toward each other until they rest on the compartment floor, and release the spring pressure.	

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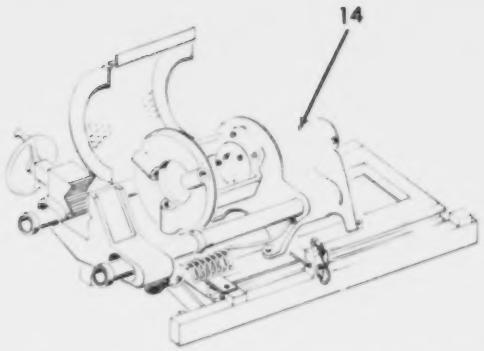
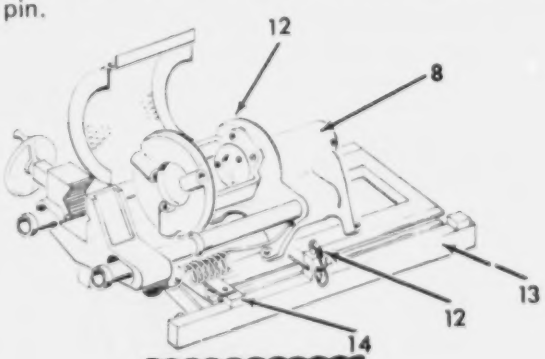


PREVENTIVE-MAINTENANCE CHECKS AND SERVICES

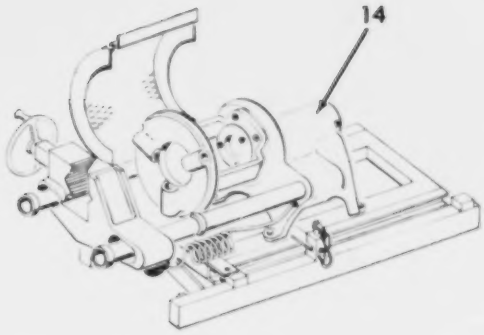
Before Operation D-During Operation A-After Operation

INTERVAL			ITEM TO BE INSPECTED PROCEDURE	FOR READINESS REPORTING EQPT IS NOT READY/ AVAILABLE IF:
B	D	A		
•			**CAUTION** MAKE SURE THAT THERE ARE NO OBSTRUCTIONS IN THE WAY OF THE TOOL BEFORE YOU SLIDE IT OUT. Remove the locking pins (12) and slide the hose end assembling tool (8) along the carriage (13) until a stop is encountered (14). Reinstall the locking pin.	



CAUTION

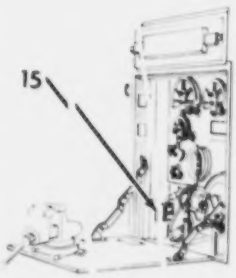
BE SURE THE HOSE COUPLING ASSEMBLER IS LOCKED IN THE OPERATING POSITION (RETAINING PINS INSTALLED AT THE CARRIAGE STOPS) BEFORE TURNING IT ON. BE SURE THE GUARD IS DOWN BEFORE OPERATING THE TOOL. DO NOT FORCE GUARD.

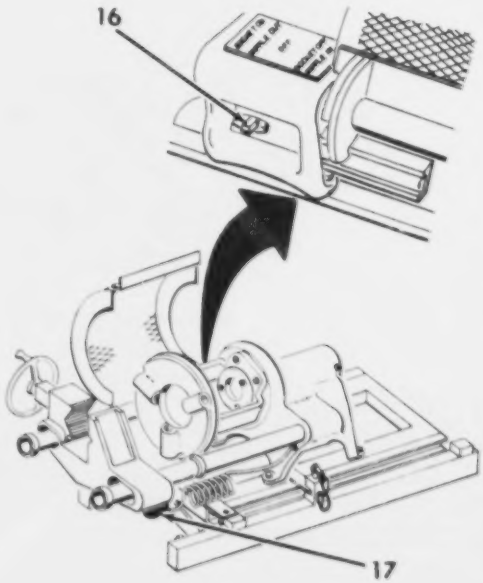


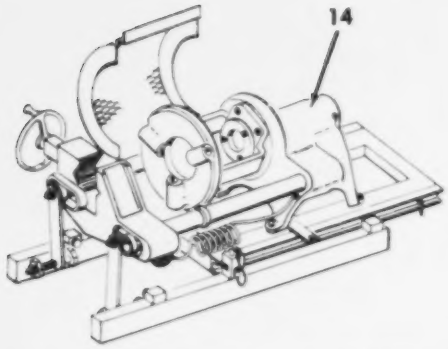
PREVENTIVE-MAINTENANCE CHECKS AND SERVICES

B-Before Operation D-During Operation A-After Operation

Item No.	INTERVAL B	D	A	ITEM TO BE INSPECTED PROCEDURE	FOR READINESS REPORTING EQPT IS NOT READY/ AVAILABLE IF:
14	●			**CAUTION** MAKE SURE SLIDING VISE IS CLEAR OF ROTATING CHUCK. Plug the hose coupling assembler into plug (15). Place the selector switch (16) in the socket on position. Squeeze hand switch (17). Observe whether or not the motor comes on line and reaches a stable speed.	



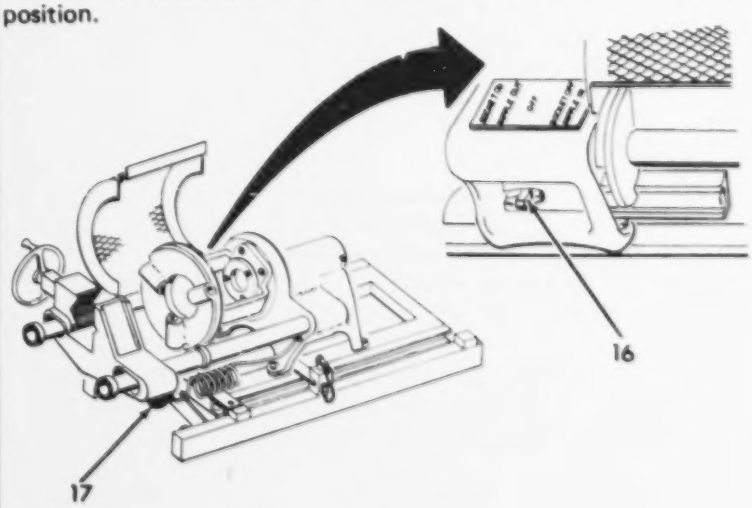


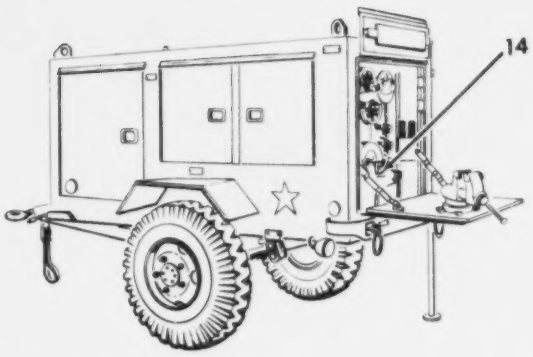


PREVENTIVE-MAINTENANCE CHECKS AND SERVICES

B-Before Operation D-During Operation A-After Operation

INTERVAL B	INTERVAL D	INTERVAL A	ITEM TO BE INSPECTED PROCEDURE	FOR READINESS REPORTING EQPT IS NOT READY/ AVAILABLE IF:
●			**NOTE** THE MACHINE SHOULD REACH A SPEED WHICH SEEMS TO YOU TO BE CONSTANT (NO VISIBLE VARIATIONS) WITHIN 15 SECONDS AFTER THE SWITCH IS TURNED ON. Release the hand switch and allow the tool to coast to a stop. Place selector switch (16) to the nipple in position. Squeeze the hand switch (17) and observe that the tool rotates in the opposite direction. Release the switch. Place the selector switch (16) in the off position.	

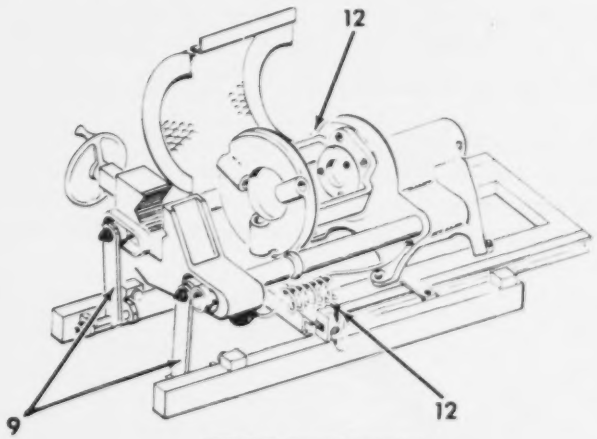




PREVENTIVE-MAINTENANCE CHECKS AND SERVICES

B-Before Operation D-During Operation A-After Operation

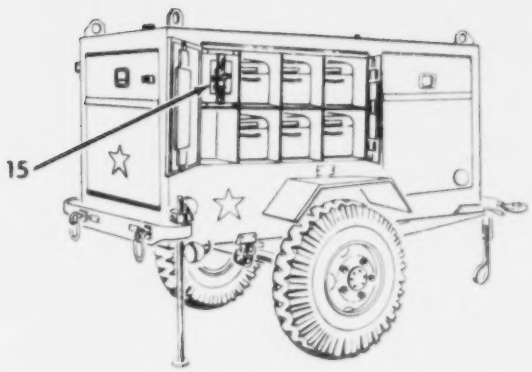
Item No.	INTERVAL B	INTERVAL D	INTERVAL A	ITEM TO BE INSPECTED PROCEDURE	FOR READINESS REPORTING EQPT IS NOT READY/ AVAILABLE IF:
14	●			Secure the hose coupling assembler. Unplug the powercord and stow it. Remove the retaining pins (12) and slide the tool to the stowed position. Reinstall the retaining pins in their first position.	



CAUTION

TO PREVENT DAMAGE, MAKE SURE NO OBSTRUCTIONS, WIRE, TUBE, ETC. ARE ON TRACK.

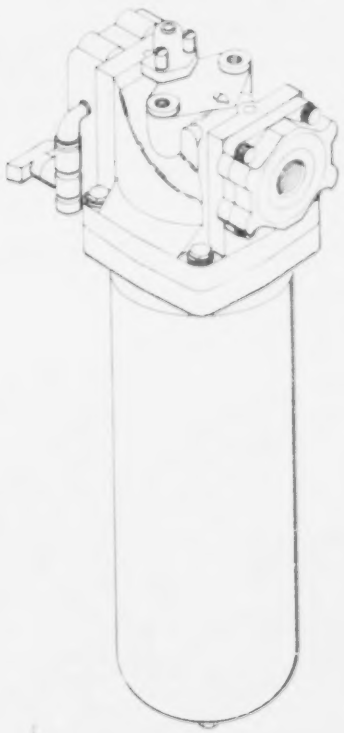
Pull back on the retaining brackets (9), compressing the springs, while rotating them to the vertical position. Allow the arms to fit against the tool as shown in the figure.

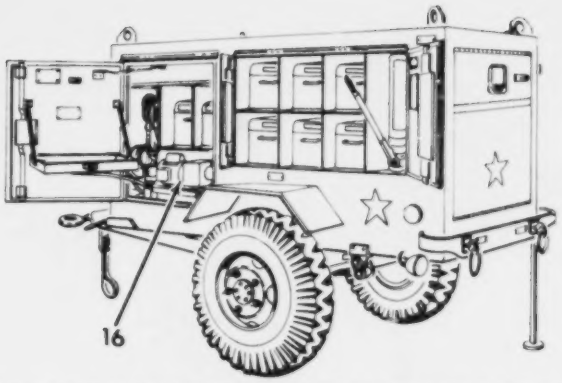


PREVENTIVE-MAINTENANCE CHECKS AND SERVICES

B-Before Operation D-During Operation A-After Operation

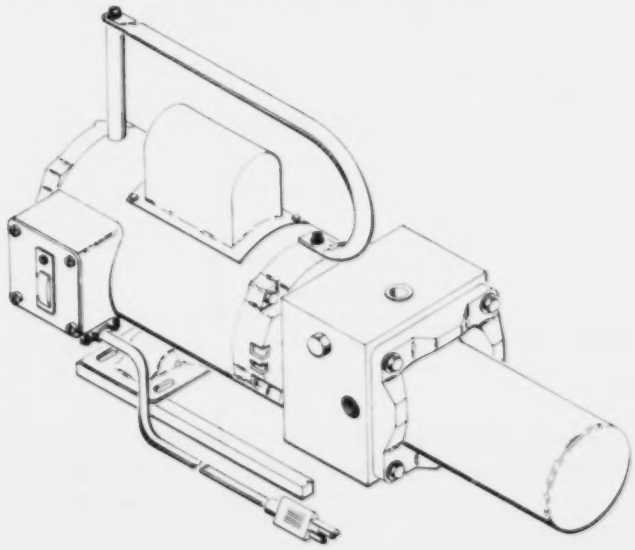
n	INTERVAL B	D	A	ITEM TO BE INSPECTED PROCEDURE	FOR READINESS REPORTING EQPT IS NOT READY/ AVAILABLE IF:
5	•			Inspect the large flushing filter. Check for evidence of damage. Stow the filter.	

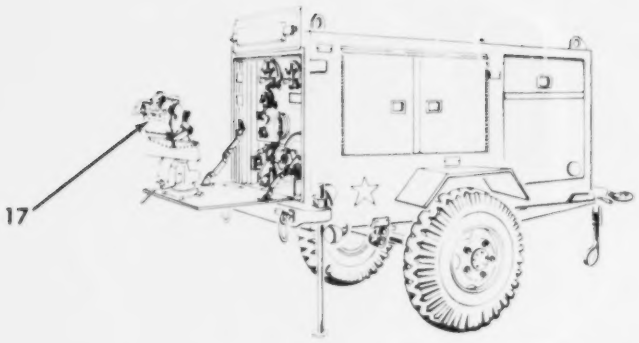




PREVENTIVE-MAINTENANCE CHECKS AND SERVICES

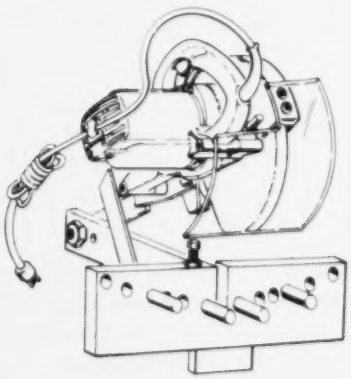
B-Before Operation D-During Operation A-After Operation

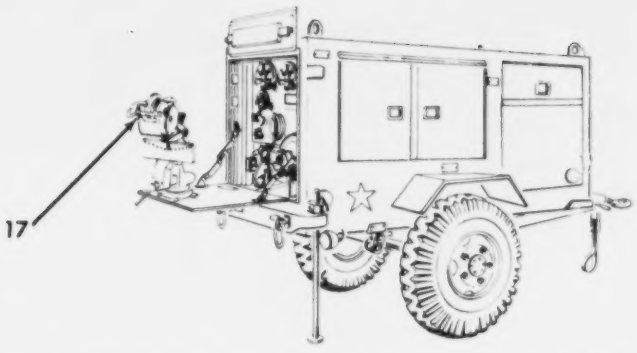
Item No.	INTERVAL B	D	A	ITEM TO BE INSPECTED PROCEDURE	FOR READINESS REPORTING EQPT IS NOT READY/ AVAILABLE IF:
16	●			Operational Check of Transfer Pump. **CAUTION** DO NOT RUN DRY FOR MORE THAN 10 SECONDS. Plug the transfer pump into an electrical outlet and turn the pump on. Run for 5-10 seconds, if pump runs properly with no evidence of irregular noise, turn the pump off, unplug and restow. 	



PREVENTIVE-MAINTENANCE CHECKS AND SERVICES

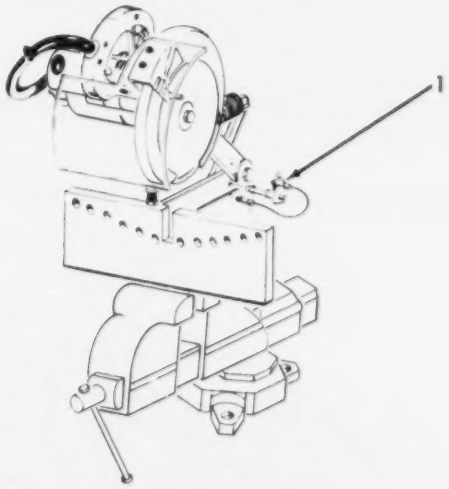
Before Operation D-During Operation A-After Operation

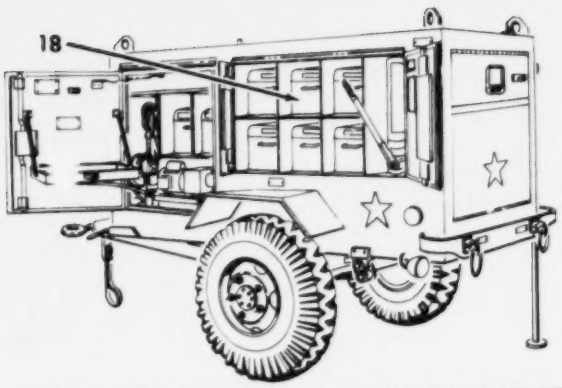
INTERVAL B	INTERVAL D	INTERVAL A	ITEM TO BE INSPECTED PROCEDURE	FOR READINESS REPORTING EQPT IS NOT READY/ AVAILABLE IF:
•			Operational Check of Hose Cutting Saw **WARNING** IF THE BLADE IS DAMAGED, DO NOT USE THE SAW. REPLACE THE BLADE FIRST. BE SURE THAT NO PERSONNEL OR EQUIPMENT ARE IN THE PATH OF THE SAW BLADE. WEAR GOGGLES WHEN TESTING THE SAW. 	



PREVENTIVE-MAINTENANCE CHECKS AND SERVICES

B-Before Operation D-During Operation A-After Operation

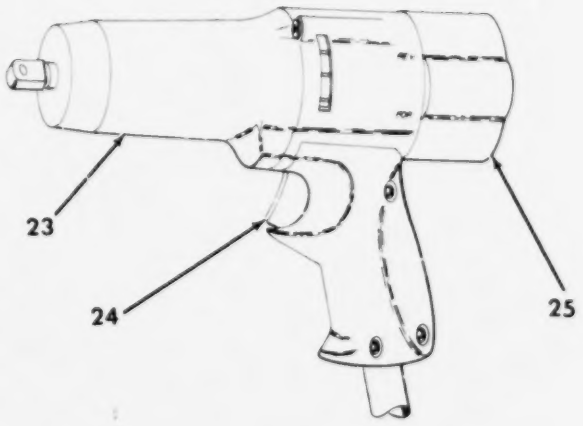
Item No.	INTERVAL B	D	A	ITEM TO BE INSPECTED PROCEDURE	FOR READINESS REPORTING EQPT IS NOT READY/ AVAILABLE IF:
17	•			Loosen the two clamps and remove the hose cutting saw from its stowage fixture. Place it in the machinists vise as shown. Remove the lock pin (1) from the saw linkage and allow the saw to raise up.  Plug the tool in and turn it on. Observe that it rotates and rapidly comes up to speed. Release the switch and allow the saw to coast to a stop. Then pull the plug out and pull the saw down, inserting the lock pin. Remove from the vise and restow.	

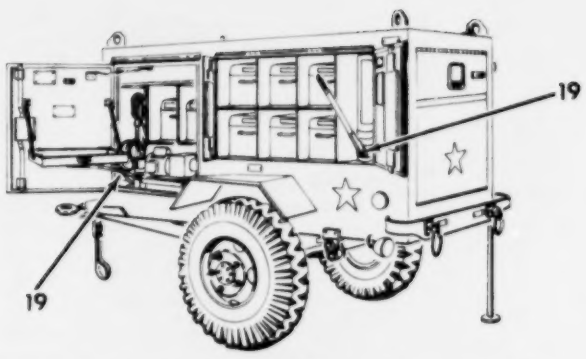


PREVENTIVE-MAINTENANCE CHECKS AND SERVICES

efore Operation D-During Operation A-After Operation

INTERVAL B	INTERVAL D	INTERVAL A	ITEM TO BE INSPECTED PROCEDURE	FOR READINESS REPORTING EQPT IS NOT READY/ AVAILABLE IF:
•			Operational Check of Impact Wrench. **CAUTION** NEVER USE SOLVENTS WHEN CLEANING PLASTIC PARTS OF THE IMPACT WRENCH. Clean the impact wrench with a soft cloth as necessary. Operate the electric impact wrench (23). Plug the tool into an electrical outlet. Using the trigger switch (24) and the rotating end cap (25), operate the tool in clockwise and counterclockwise directions. Unplug the tool and stow.	

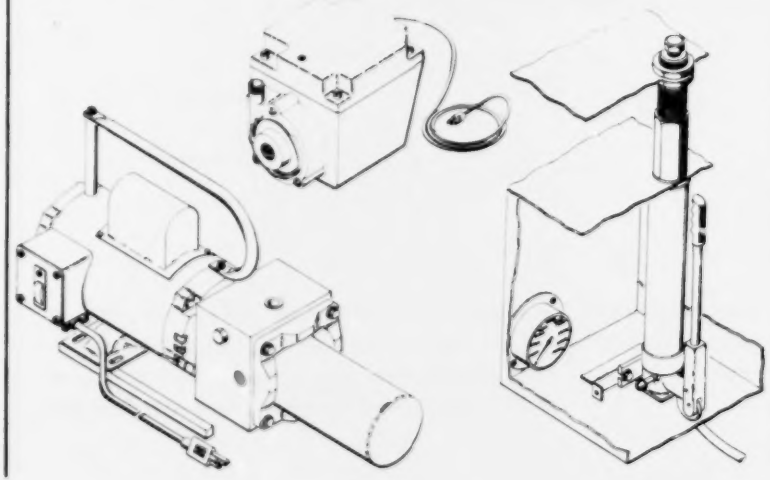


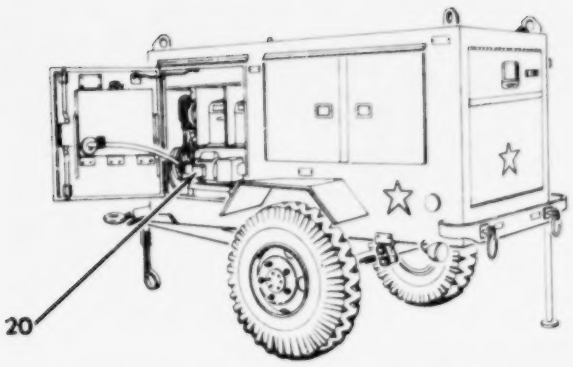


PREVENTIVE-MAINTENANCE CHECKS AND SERVICES

B-Before Operation D-During Operation A-After Operation

Item No.	INTERVAL B	INTERVAL D	INTERVAL A	ITEM TO BE INSPECTED PROCEDURE	FOR READINESS REPORTING EQPT IS NOT READY/ AVAILABLE IF:
19		•		Pump Operation Check. While you are operating any of the hydraulic pumps in the HSTRU, be sure to watch for any sudden, unexplained losses of pump pressure. Also be sure to watch for any leaks or spurts of hydraulic fluid under pressure. Take care to notice any fumes or unusual noises coming from the pumps. **WARNING** IF YOU DETECT SMOKE, FUMES, OR UNUSUAL NOISES COMING FROM A HYDRAULIC COMPONENT, SHUT THAT COMPONENT DOWN IMMEDIATELY.	

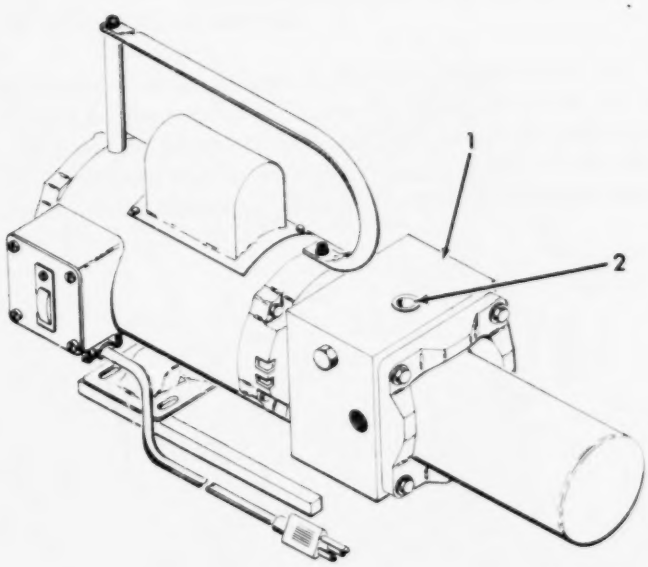


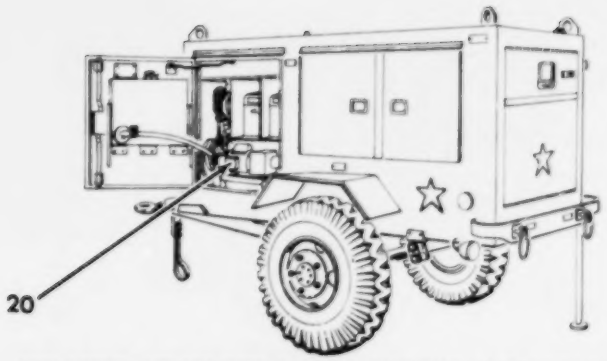


PREVENTIVE-MAINTENANCE CHECKS AND SERVICES

B-Before Operation D-During Operation A-After Operation

	INTERVAL			ITEM TO BE INSPECTED PROCEDURE	FOR READINESS REPORTING EQPT IS NOT READY/ AVAILABLE IF:
	B	D	A		
		•		Filter Bypass Check. When using the transfer pump (1) periodically check the filter indicator (2).	

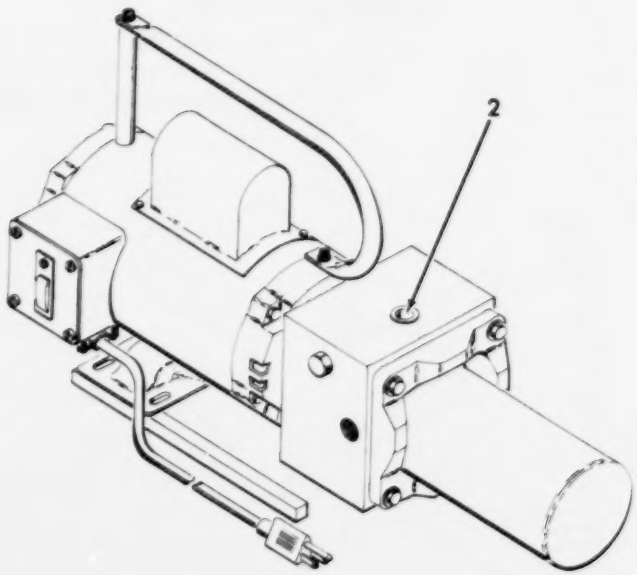


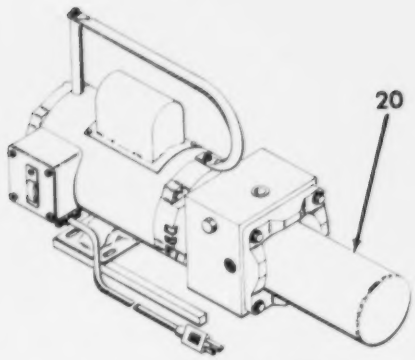


PREVENTIVE-MAINTENANCE CHECKS AND SERVICES

B-Before Operation D-During Operation A-After Operation

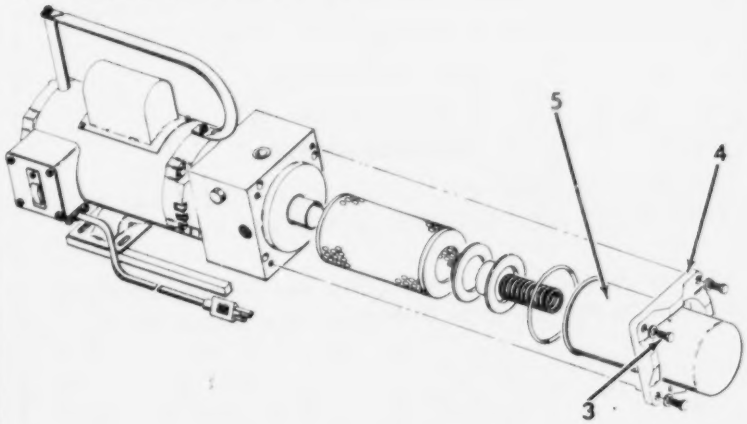
Item No.	INTERVAL B	INTERVAL D	INTERVAL A	ITEM TO BE INSPECTED PROCEDURE	FOR READINESS REPORTING EQPT IS NOT READY/ AVAILABLE IF:
20		•		If the spindicator on the transfer-pump spins during operation, the filter has become clogged and the oil is being bypassed around it. If the transfer pump filter indicator (2) indicates bypassing, turn the transfer pump off and change the filter.	

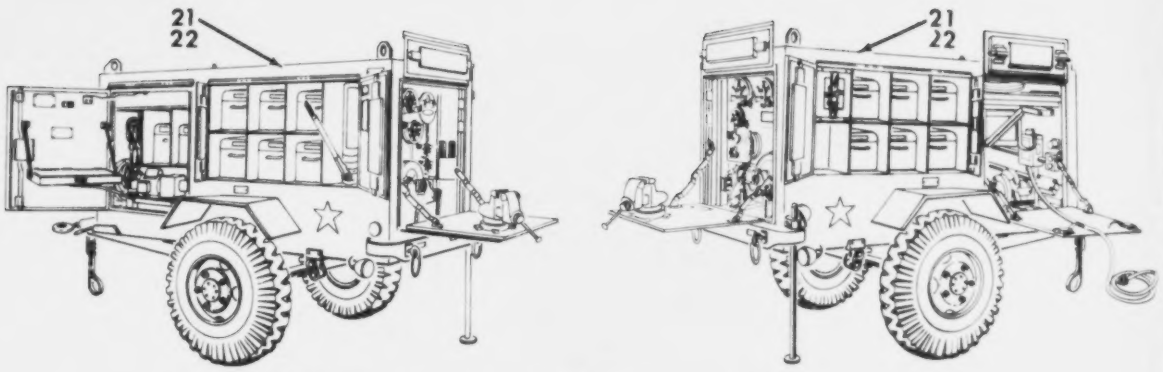




PREVENTIVE-MAINTENANCE CHECKS AND SERVICES

lefore Operation D-During Operation A-After Operation

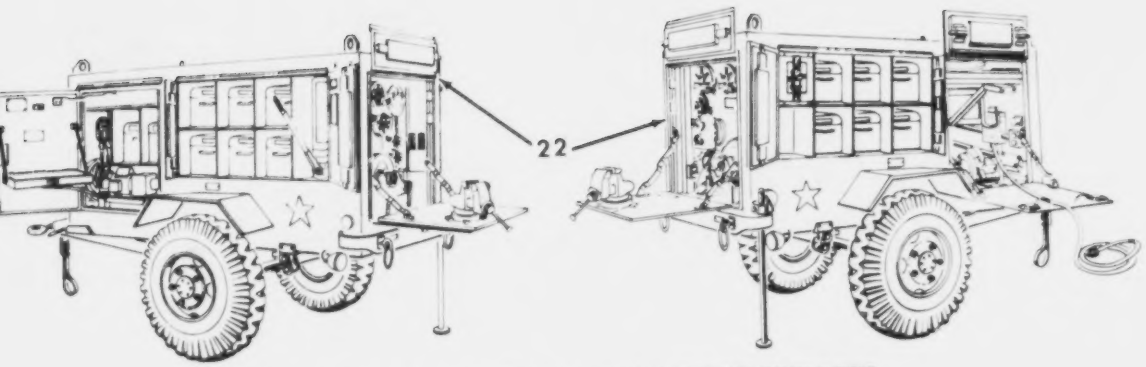
INTERVAL B	INTERVAL D	INTERVAL A	ITEM TO BE INSPECTED PROCEDURE	FOR READINESS REPORTING EQPT IS NOT READY/ AVAILABLE IF:
	•		**WARNING** HOLD HOUSING IN PLACE WHEN REMOVING CAP SCREWS BECAUSE THERE IS A STRONG SPRING INSIDE THE HOUSING WHICH MIGHT SHOOT THE HOUSING OFF WHEN THE CAP SCREWS ARE REMOVED. Remove four hex head cap screws (3). Remove filter retaining ring (4) and enclosure bowl (5). Clean the inside of the enclosure bowl and thepump housing guide tube with a clean lint free rag. Lubricate grommet seal on the new element and slide it over the guide tube. Inspect enclosure bowl o-ring first. Reassemble with new filter element to the pump. 	



PREVENTIVE-MAINTENANCE CHECKS AND SERVICES

B-Before Operation D-During Operation A-After Operation

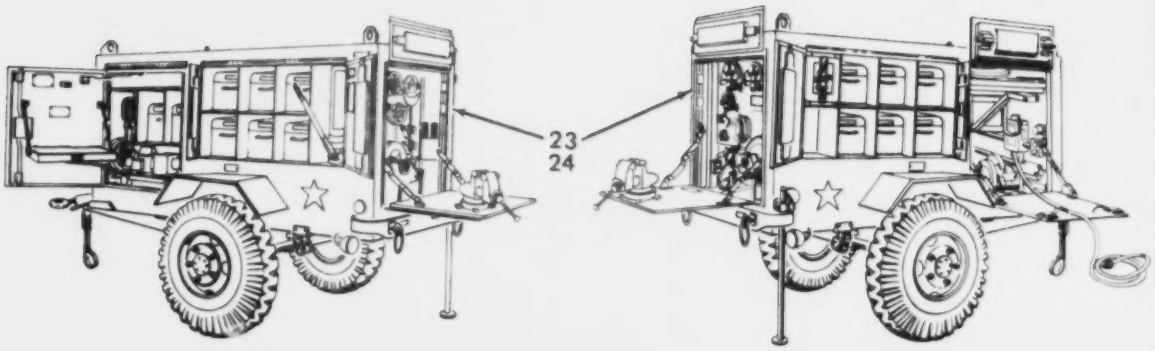
Item No.	INTERVAL B	INTERVAL D	INTERVAL A	ITEM TO BE INSPECTED / PROCEDURE	FOR READINESS REPORTING EQPT IS NOT READY/ AVAILABLE IF:
21		•		FOD Prevention Check. As you use the HSTRU, you should make certain that no possibility of foreign object damage has been created. In order to prevent FOD, replace each tool in its proper place after use. Do not permit debris such as safety wire, washers, nuts, and other bits of hardware to accumulate in the work area. Make certain that all moving parts of all components are free from potential obstruction prior to turning them off. Remember, only you can prevent FOD.	
22	•	•	•	Smoke, Acrid Fumes. As you use the HSTRU, you should always be alert for smoke and/or acrid fumes. Almost all types of commonly used military hydraulic fluids and oils are flammable. The fumes given off by certain types of hydraulic fluid are toxic. For your own safety and for the safety of the equipment, pay careful attention to the possibility of smoke or fumes. **WARNING** IF YOU SMELL SMOKE OR FUMES WHILE OPERATING THE HSTRU, SHUT IT DOWN IMMEDIATELY. Emergency shut down of the HSTRU may be accomplished by turning the circuit breaker (PMCS 4) to the off position.	



PREVENTIVE-MAINTENANCE CHECKS AND SERVICES

B-Before Operation D-During Operation A-After Operation

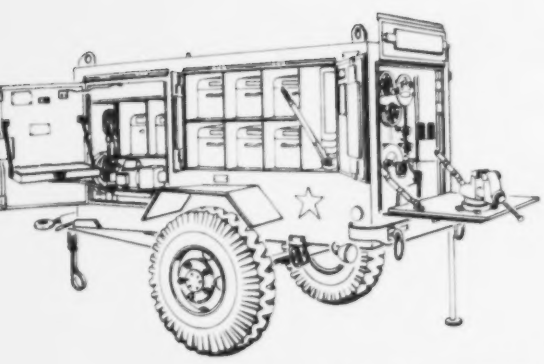
Item No.	INTERVAL B	INTERVAL D	INTERVAL A	ITEM TO BE INSPECTED / PROCEDURE	FOR READINESS REPORTING EQPT IS NOT READY/ AVAILABLE IF:
22	•	•	•	**WARNING** IF IT BECOMES NECESSARY FOR YOU TO REMOVE THE GROUND PLUG FROM THE HSTRU, ENSURE THAT EXTERNAL POWER SUPPLY OUTPUT IS DISENGAGED FIRST. IF, FOR SOME REASON, YOU CANNOT SHUT OFF EXTERNAL POWER FROM THE HSTRU AT THE CIRCUIT BREAKER BOX (PMCS 4, CALLOUTS 4-8), SHUT IT OFF AT THE SOURCE. REMOVING THE PLUG WHILE POWER IS ON IS THE LAST RESORT.	

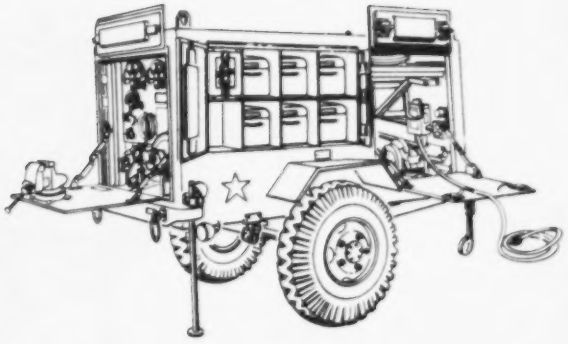


PREVENTIVE-MAINTENANCE CHECKS AND SERVICES

B-Before Operation D-During Operation A-After Operation

Item No.	INTERVAL B	INTERVAL D	INTERVAL A	ITEM TO BE INSPECTED / PROCEDURE	FOR READINESS REPORTING EQPT IS NOT READY/ AVAILABLE IF:
23			•	Post Operation Inspection. After you finish using the HSTRU, carefully inspect all tools and components, which you have used, for damage incurred during operation.	
24			•	Secure Tools and Components. After you finish using the HSTRU, carefully stow all tools, components, and supplies in their proper places. Dispose of scrap materials, dirty rags, etc. in the proper fashion. **CAUTION** BE SURE THAT NO TOOLS OR SCRAPS ARE LEFT IN LOCATIONS WHERE THEY COULD CAUSE FOD. Make sure all power tools are turned off and unplugged. Make sure the cords are properly stowed. Close all electrical receptacle covers.	

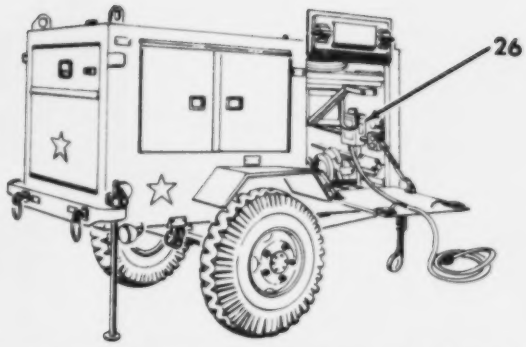




PREVENTIVE-MAINTENANCE CHECKS AND SERVICES

B-Before Operation D-During Operation A-After Operation

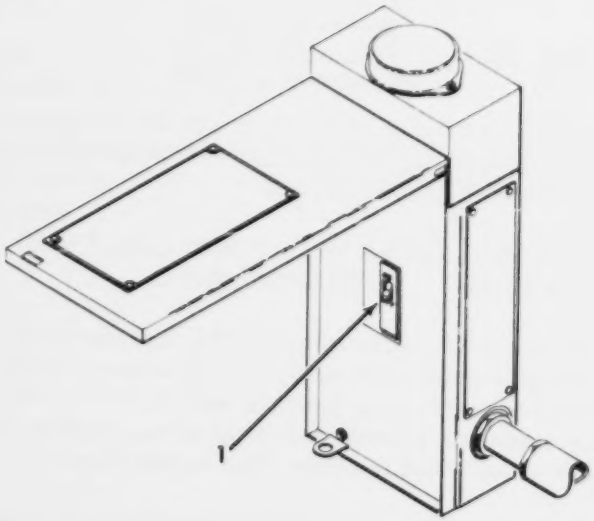
em no.	INTERVAL B	INTERVAL D	INTERVAL A	ITEM TO BE INSPECTED PROCEDURE	FOR READINESS REPORTING EQPT IS NOT READY/ AVAILABLE IF:
25			•	Clean Up. After all tools and supplies have been properly stowed, carefully wipe any fluid spills. Wipe down each hydraulic tool or component. Wipe all dirt, dust, and grime from the interior of the HSTRU. **WARNING** SHUT OFF AND DISCONNECT ALL POWER TO THE HSTRU PRIOR TO ANY WASHING. **CAUTION** BE SURE THAT ALL ELECTRICAL RECEPTACLES ARE COVERED AND ALL HYDRAULIC FITTINGS CLOSED PRIOR TO INTERIOR WASHING. REMOVE TOOL BOXES, HOSE, POWER CABLE, AND TUBING PRIOR TO INTERIOR WASHING. In cases where the interior of the HSTRU is exceptionally dirty and cannot be gotten sufficiently clean by wiping and local washing, thoroughly wash down the interior of the trailer after removing all tools. Remove drain plugs located inside rear door on floor so wash fluid can drain. Then replace plugs. Carefully latch all doors and wash the exterior of the trailer.	

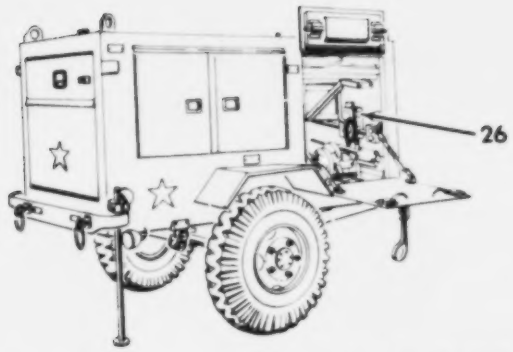


PREVENTIVE-MAINTENANCE CHECKS AND SERVICES

B-Before Operation D-During Operation A-After Operation

Item No.	INTERVAL B	INTERVAL D	INTERVAL A	ITEM TO BE INSPECTED PROCEDURE	FOR READINESS REPORTING EQPT IS NOT READY/ AVAILABLE IF:
26			●	External Power Removal. **WARNING** BE SURE ALL COMPONENT SWITCHES ARE IN THE OFF POSITION PRIOR TO REMOVING EXTERNAL POWER. Place the circuit breaker in the main power panel box (1) to the off position.	

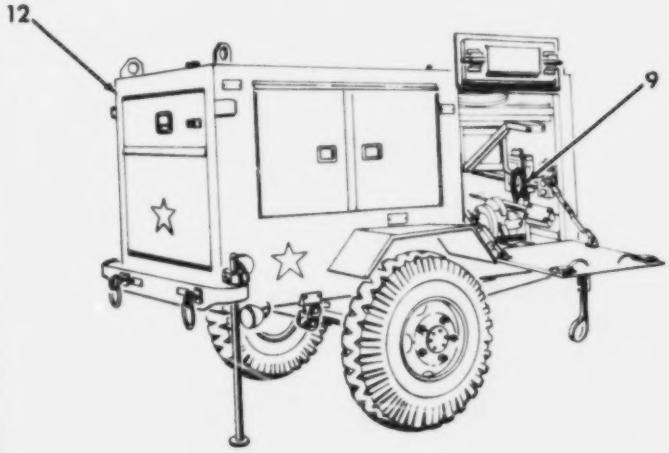


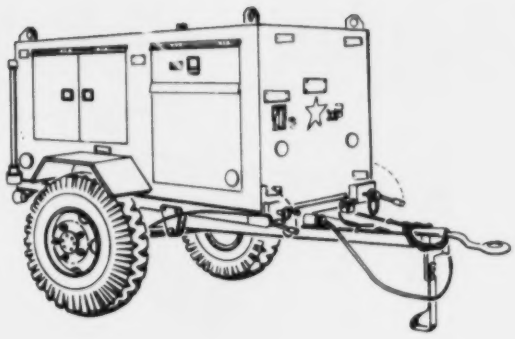


PREVENTIVE-MAINTENANCE CHECKS AND SERVICES

efore Operation D-During Operation A-After Operation

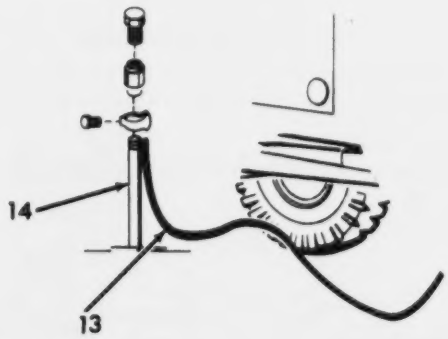
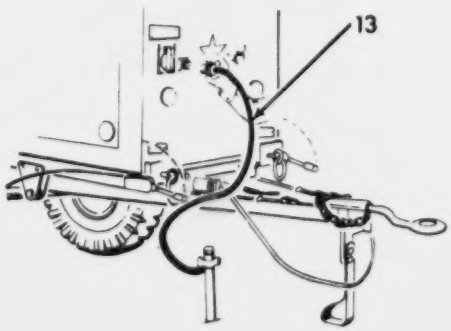
INTERVAL B	INTERVAL D	INTERVAL A	ITEM TO BE INSPECTED PROCEDURE	FOR READINESS REPORTING EQPT IS NOT READY/ AVAILABLE IF:
		•	Disconnect the external power cord (9) from the source of external power. Coil the cord (9) neatly and stow it in the HSTRU (12).	

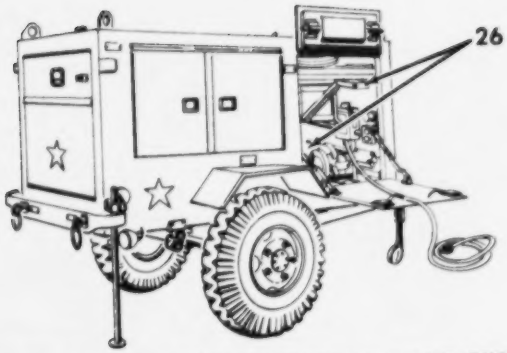




PREVENTIVE-MAINTENANCE CHECKS AND SERVICES

B-Before Operation D-During Operation A-After Operation

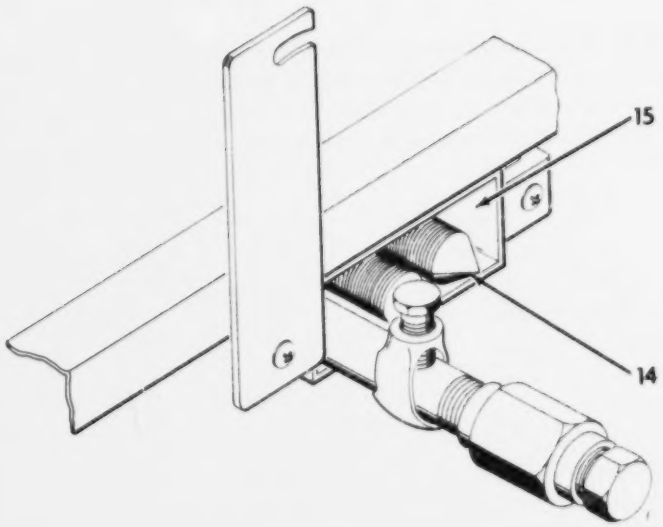
Item No.	INTERVAL B	INTERVAL D	INTERVAL A	ITEM TO BE INSPECTED PROCEDURE	FOR READINESS REPORTING EQPT IS NOT READY/ AVAILABLE IF:
26			•	Disconnect the ground wire (13) from the ground stake (14).  Disconnect the ground wire (13) from the trailer and reinstall protective cap.  	

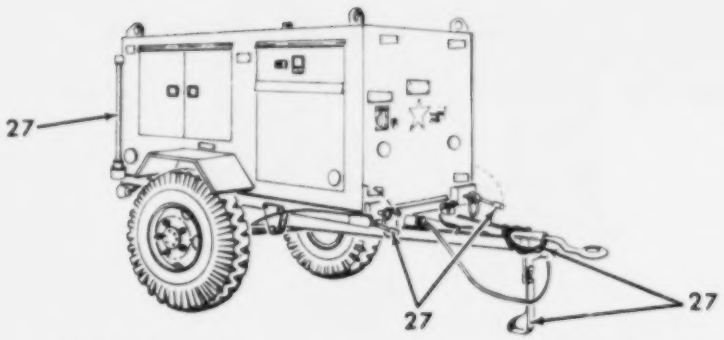


PREVENTIVE-MAINTENANCE CHECKS AND SERVICES

-Before Operation D-During Operation A-After Operation

INTERVAL B	INTERVAL D	INTERVAL A	ITEM TO BE INSPECTED PROCEDURE	FOR READINESS REPORTING EQPT IS NOT READY/ AVAILABLE IF:
		•	Coil the ground wire neatly and stow it in the trailer. Remove the ground stake from the ground and clean it thoroughly. Disassemble and stow the ground stake (14) in the ground stake compartment (15).	

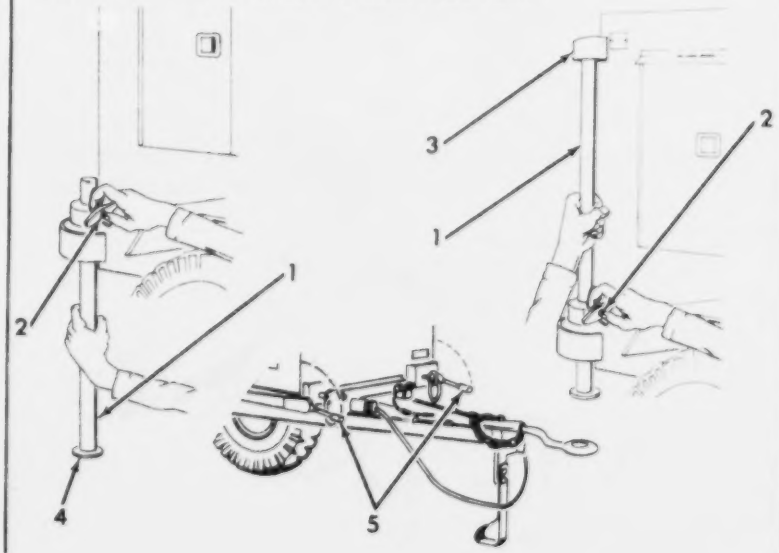


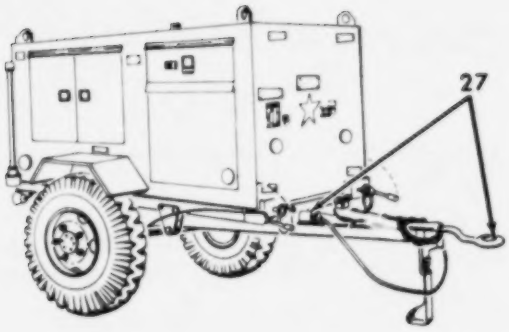


PREVENTIVE MAINTENANCE CHECKS AND SERVICES

B-Before Operation D-During Operation A-After Operation

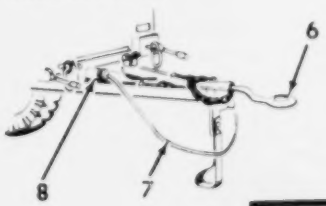
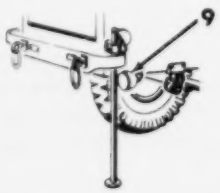
Item No.	INTERVAL B	INTERVAL D	INTERVAL A	ITEM TO BE INSPECTED PROCEDURE	FOR READINESS REPORTING EQPT IS NOT READY/ AVAILABLE IF:
27			•	Towing Hookup. Secure the stabilizer leg (1) by removing the pin (2) and pushing the leg up to the stowage socket (3). Reinstall the pin in the hole in the leg which lines up with the guide bracket (See PMCS 2). Screw foot (4) up tight. Release the hand brakes (5) by raising them to the up position (See PMCS 1). Using a tire pressure gage, check the air pressure in both tires. Service the tires for proper pressure (50 PSI).	

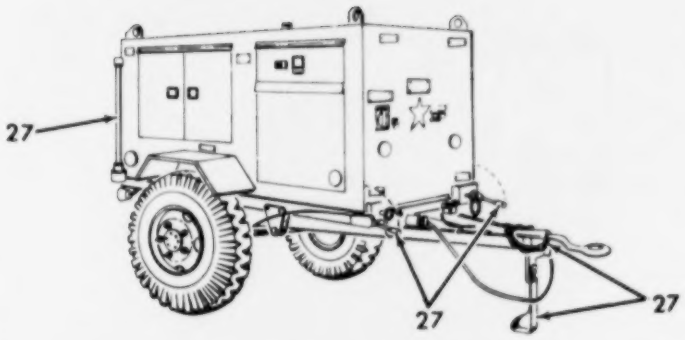




PREVENTIVE-MAINTENANCE CHECKS AND SERVICES

B-Before Operation D-During Operation A-After Operation

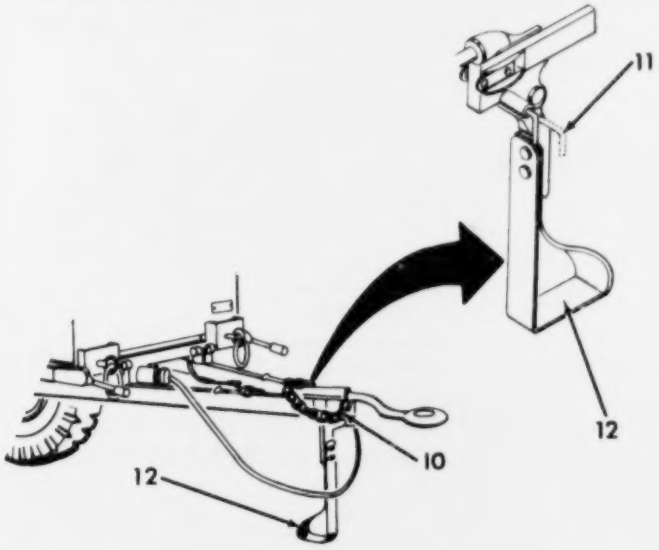
m	INTERVAL B	INTERVAL D	INTERVAL A	ITEM TO BE INSPECTED / PROCEDURE	FOR READINESS REPORTING EQPT IS NOT READY/ AVAILABLE IF:
7			•	Hook the lunette eye (6) to the tow hitch of the towing vehicle. **NOTE** IF THE TOWING VEHICLE IS EQUIPPED WITH A PINTILE TYPE HOOK, BE SURE TO CLOSE THE UPPER JAW AND INSERT THE SAFETY PIN. Remove the tail light cable (7) from its stowage bracket (8) and plug it in to the towing vehicle's tow cable plug. Check the brake lights and turn signals (9) of the trailer by applying the tow vehicle's brake and turn signals. Report any deficiencies IAW TM 38-750 (TAMMS).   **NOTE** BE SURE THE TAIL LIGHT CABLE IS SECURELY PLUGGED IN. INSPECT THE HSTRU TO ENSURE THAT ALL TOOLS AND SUPPLIES ARE PROPERLY STOWED AND SECURED. BE SURE THAT ALL DOORS ARE CLOSED AND SECURE.	



PREVENTIVE-MAINTENANCE CHECKS AND SERVICES

B-Before Operation D-During Operation A-After Operation

Item No.	INTERVAL B	INTERVAL D	INTERVAL A	ITEM TO BE INSPECTED PROCEDURE	FOR READINESS REPORTING EQPT IS NOT READY/ AVAILABLE IF:
27			•	**CAUTION** MAKE SURE LANDING LEG IS LOCKED IN THE UP POSITION. Attach the safety chains (10) to the tow vehicle. Pull out the landing leg pin (11) on the lunette and fold the landing leg (12) back to the up position. Release the pin. Be sure the pin returns to the lock position.	



SECTION IV

OPERATION UNDER USUAL CONDITIONS

2-5. General. This section provides step-by-step instructions necessary for use of the HSTRU under normal conditions.

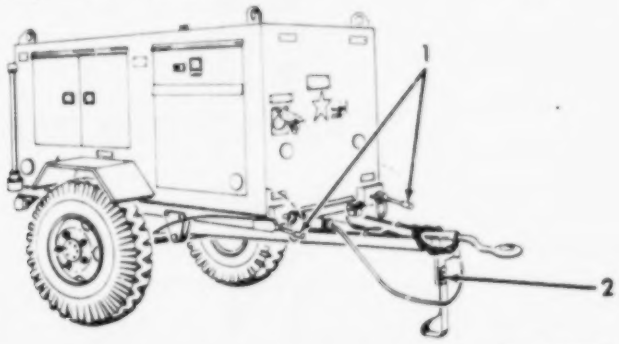
2-6. Preparation for use. There are several things which you must do before using the HSTRU. The following procedure describes those things. Do them in the order in which they appear in the procedure.

a. Before you unhook the HSTRU from the tow vehicle, set the hand brakes (1) and lower the landing gear leg (2), (See item 1 PMCS). If the towing vehicle is the contact maintenance truck, it is not necessary to unhook. Make sure you have moved the brake handle all the way to the engaged position. Then deploy the stabilizer leg (See item 2 PMCS). Now unhook the brake light and turn signal cable, safety chains, and the hitch.

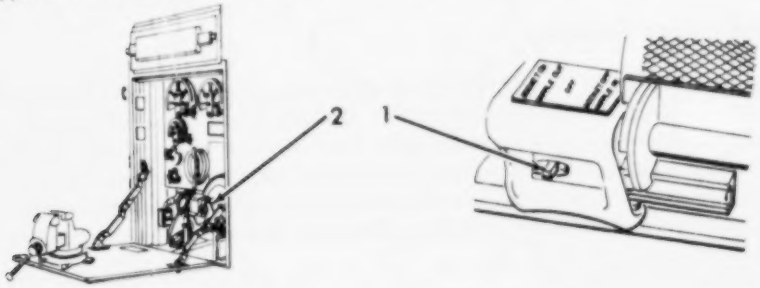
WARNING

BE SURE THE HSTRU IS PROPERLY GROUNDED BEFORE APPLYING ELECTRICAL POWER.

b. Assemble and connect the ground stake. Deploy the fire extinguisher. See item 3 PMCS.



c. Prior to operation, inspect each power tool and component that will be used and ensure that all switches are in the off position before plugging in any of the tools or components. Walk to the back of the trailer. Locate the power switch (1) on the hose coupling assembler (2). This switch is found on the lower left hand side of the tool. It is a toggle type switch (3 position). The forward and reverse positions are labeled, "socket-on-nipple-out" and "socket-off-nipple-in". Ensure that the switch is in the off position (center position).



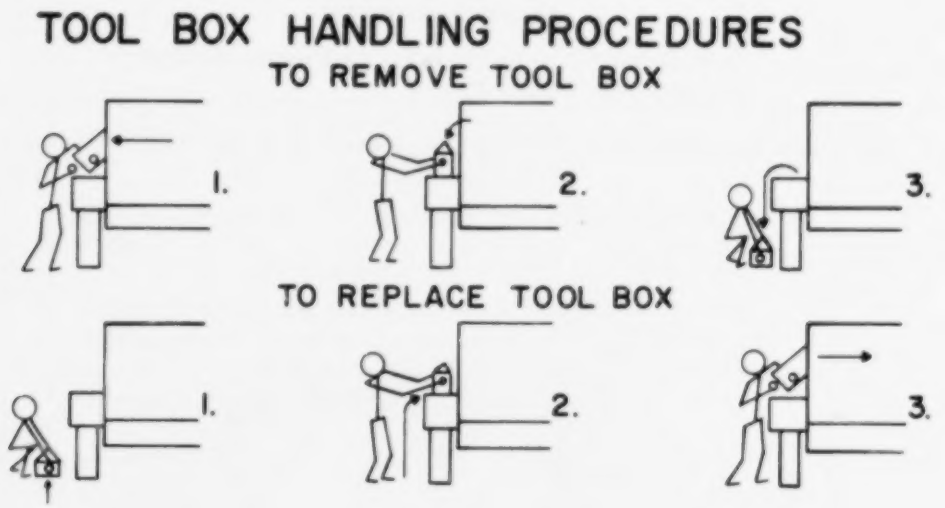
d. Connect the external power cable to a source of 120 VAC 60 Hz single phase power, if available. (See item 4 and 5 PMCS).

(1) Field Generator. Connect the HSTRU to field generators in accordance with the applicable generator manuals, for 120V 60 Hz.

(2) Contact Trucks. Connect the HSTRU to the contact truck for 120 VAC operation.

2-7. Initial Adjustment, Daily Checks and Self Test. Initial adjustment of the HSTRU components is not required. Daily checks and self test items are covered in the PMCS, items 1 through 20 and 22 through 26.

2-8. Operating Procedure. Prepare the HSTRU for use in accordance with the procedure in paragraph 2-6, Preparation for Use. Perform your (B) PMCS, prior to operation. Perform your (D) PMCS, during operation. These items will cover preparation of the HSTRU for use with power on. When electrical power is not available, many of the HSTRU functions can still be performed. Hand tools necessary to support this contingency have been included in the HSTRU. Refer to TM5-350, Hydraulic Systems, for general hydraulic system information. When removing or replacing toolboxes in the HSTRU, be sure to follow the handling procedure shown here so that you will not injure yourself.



2-9. Operation of Auxilliary Equipment. The HSTRU is equipped with numerous power tools and hand tools. These tools are the ones which you will need to test and repair hydraulic systems. Brief descriptions of these tools and their uses are included in Chapter 1. The following paragraphs will completely describe the operation of each of the power tools and components. They will also describe the use of the special hand tools.

2-10. Hose Coupling Application.

a. Hose Selection. Select the proper type and size of hose. One way to do this is to look at the end of the hose which you are replacing and count the layers of wire. Always use hose which has the same number of layers of wires as the one you are replacing. If you are replacing the entire hose assembly, the hose you select may also have more layers of wires, but never fewer than the hose being replaced. Table 2-2 can be used to determine the correct type of hose for the system which is being repaired. Always select the hose with a maximum working pressure which equals or exceeds the system relief valve setting (determine the system relief valve setting by checking the manual for the system being repaired).

HOSE TYPE	HOSE SIZE (I.D.) INCH/DASH										
	3/16 -3	1/4 -4	5/6 -5	3/8 -6	1/2 -8	5/8 -10	3/4 -12	1 -16	1-1/4 -20	1-1/2 -24	2 -32
MIL-H-13444 Type I, single fiber braid		350		300	300	250	250				
MIL-H-13531 Type I Class A, single wire braid, no skive	3000	2750	2500	2250	2000		1250	1000			
Type II Class A, double wire braid	5000	5000		4000	3500		2250	2000	1625	1250	1125
Class B, double wire braid, no-skive	5000	5000		4000	3500		2250	2000	1625	1250	1125
MIL-H-52471 Type R1 single wire braid	3000	2750	2500	2250	2000		1250	1000			
Type R2 double wire braid	5000	5000		4000	3500		2250	2000	1675	1250	1125
Type R10 four heavy spiral wire wrap								4000	3000	2500	2500

This Chart can be used as a guide in selecting a hose by size and recommended working pressure.
Pressure is PSI.

NOTE

YOU MUST KNOW MAXIMUM SYSTEM OPERATING PRESSURES IN ORDER TO SELECT PROPER TYPE HOSES.

THE SIZE OF THE HOSE IS MARKED BY SIXTEENTHS OF AN INCH, REFERRING TO THE INNER DIAMETER. FOR EXAMPLE, -8 HOSE HAS AN 8/16 OR A 1/2 INCH INNER DIAMETER.

b. Hose Cutting.

WARNING

BE SURE THAT ALL PERSONNEL, SUPPLIES, AND EQUIPMENT ARE CLEAR OF THE SAW BLADE PRIOR TO TURNING IT ON.

EVEN AFTER POWER HAS BEEN REMOVED FROM THE HOSE CUTTING TOOL, THE BLADE WILL CONTINUE TO TURN AT SPEEDS SUFFICIENT TO INFLICT SERIOUS INJURY. DO NOT TOUCH THE HOSE CUTTING SAW BLADE UNTIL IT HAS REACHED A COMPLETE STOP.

CAUTION

BE SURE THE SAW IS RUNNING AT OPERATING SPEED BEFORE STARTING TO CUT ANY HOSE.

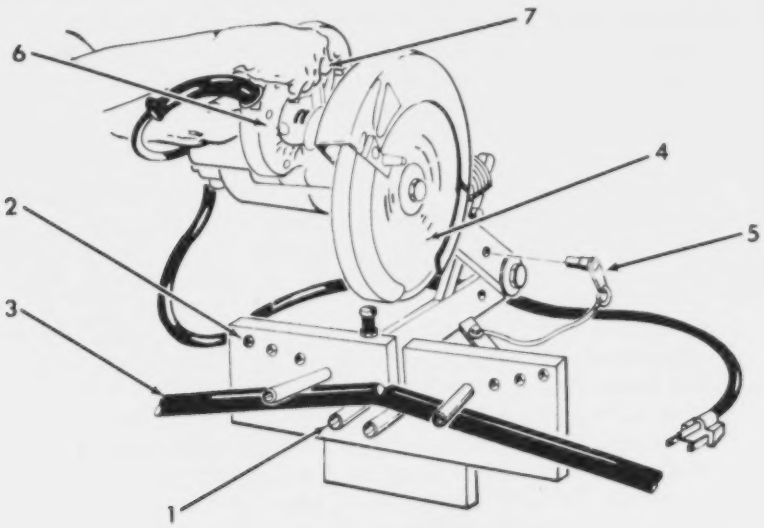
THE SAW HAS A FRICTION BURN BLADE. IF IT IS PRESSED HARD INTO THE HOSE FOR TOO LONG AT A TIME, THE BLADE WILL OVERHEAT. WHEN IT OVERHEATS, IT WILL WARP AND CONTACT THE SAW HOUSING. IF THIS OCCURS, RELEASE THE SWITCH AND RAISE THE SAW. WHEN THE SAW BLADE HAS STOPPED TURNING, INSPECT IT FOR CRACKS (INCLUDING HAIRLINE CRACKS). DO NOT USE A CRACKED BLADE.

NOTE

THE HOSE CUTTING SAW IS DESIGNED TO CUT HOSE UP TO 2" I.D.

The hose must be cut to the correct length. Measure and mark the hose. Use the old hose to determine length if it is available. If it is not, keep in mind that the couplings will add length to the completed hose assembly. The power saw used for cutting the hose is a 120 volt electric saw. Before using the saw, perform item 17, (B) PMCS.

Item 17 (B) PMCS shows how to position the saw for use, plug it in, and turn it on. After the hose cutting saw has been secured in the operating position, insert the guide pins, (1) in the holes in the holder (2) which corresponds to the diameter of the hose to be cut (3). Remove the pull pin (5) from the linkage. Be sure the hose is securely held and is at a right angle to the plane of the saw blade (4). The hose should be in a curved position as shown (3). In this way the hose will pull away from the blade as it is cut and will not bind against the blade.



WARNING

WEAR GOGGLES AND WORK GLOVES WHILE OPERATING THE HOSE CUTTER SAW. FAILURE TO DO SO MAY RESULT IN SERIOUS EYE OR HAND INJURY.

NOTE

HOSE MAY BE CUT WITH A HACKSAW AND AN ABRASIVE BLADE IF ELECTRICAL POWER IS UNAVAILABLE.

Grasp the saw handle (6) and squeeze the switch button (7) with your index finger. When the saw blade has begun to rotate at operating speed, lower the saw down to contact the hose and cut through it. The hose cutting saw works best if it is advanced slowly through the hose. This will allow the blade to operate at the optimum speed, resulting in a smooth cut. With some of the heavier hoses, it will be necessary to cut for a few seconds and then allow the saw to cool for a few seconds by raising the saw with the blade turning. Repeat this cycle until the cut is complete.

When the hose has been cut through, rotate the saw back to its original position and release the switch button. As you use the hose cutting saw, observe your (D) PMCS. When you finish using the hose cutting saw, stow the saw by using the procedure in item 17, PMCS.

c. *Hose Skiving*. Select a proper coupling. Couplings marked R-1 can be used with hose marked R-1, or marked MIL-H-13531 type I. Couplings marked R-2 can be used with hose marked R-2 or marked MIL-H-13531,

type II. Couplings marked R-10 can be used with hose marked R-10. If couplings from the old hose assembly are to be reused, the type of hose selected must match the old hose.

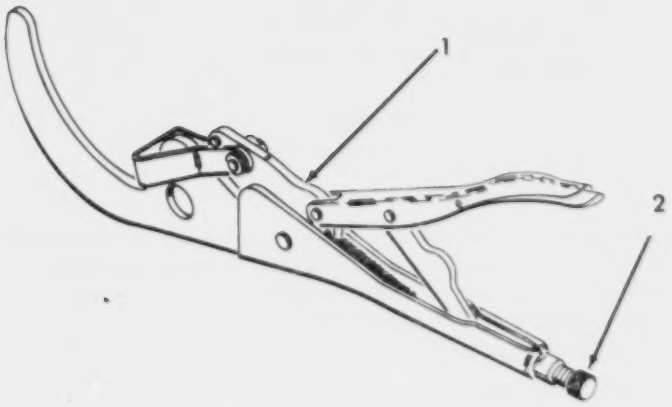
NOTE

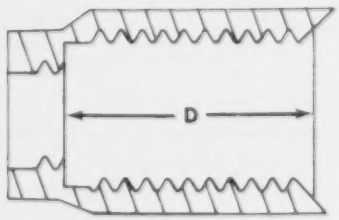
BE SURE THAT YOU SELECT THE PROPER COUPLING. COUPLING SIZES ARE MARKED ON THE FITTING. SELECT A COUPLING THAT IS THE SAME SIZE AS THE HOSE WHICH YOU ARE GOING TO USE. FOR EXAMPLE, USE A -8 COUPLING WITH A -8 HOSE.

CERTAIN TYPES OF HOSE AND FITTINGS ARE OF A DESIGN WHICH DOES NOT REQUIRE SKIVING. IF BOTH HOSE AND FITTINGS ARE MARKED NO-SKIVE, SKIVING IS NOT NECESSARY. ALL OTHER APPLICATIONS WILL REQUIRE SKIVING.

A SET OF MANDRELS IS PROVIDED WITH THE HSTRU FOR USE DURING SKIVING OPERATIONS. SELECT THE PROPER SIZE MANDREL AND INSERT IT INTO THE END OF THE HOSE. LEAVE ENOUGH OF THE MANDREL STICKING OUT OF THE END OF THE HOSE SO THAT THE MANDREL CAN BE REMOVED FROM THE HOSE. THIS WILL PREVENT CRUSHING THE HOSE WHEN IT IS CLAMPED IN THE VISE. BE SURE TO REMOVE THE MANDREL BEFORE ATTACHING THE HOSE COUPLING.

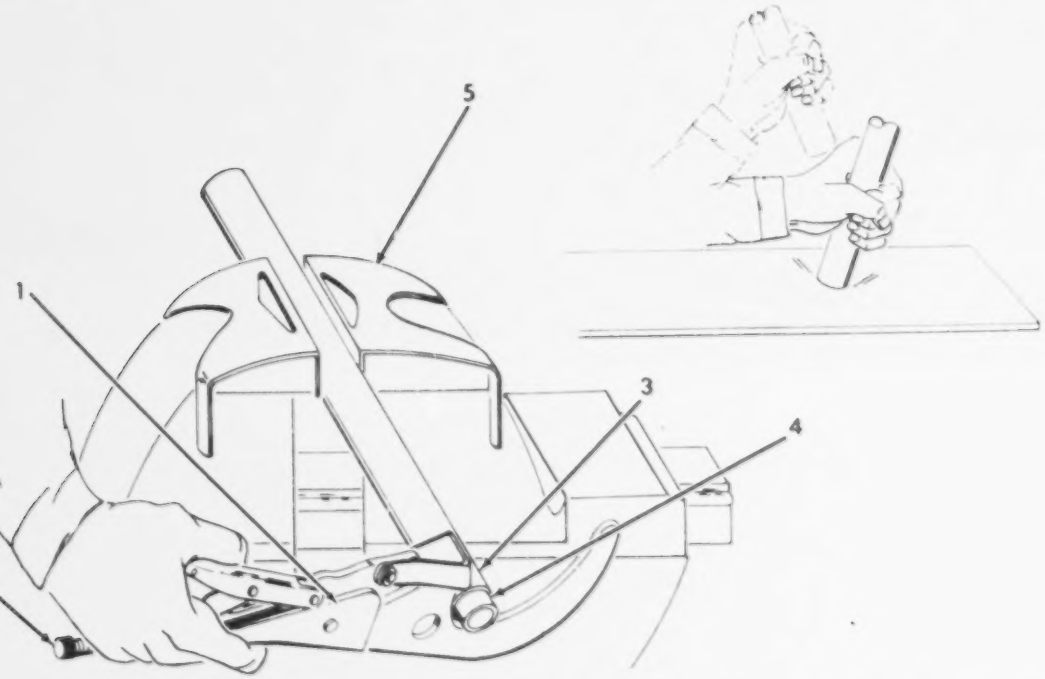
Skiving is done with a hose skiving tool (1). This tool may be adjusted to accomodate any hose diameter commonly associated with hydraulic systems, by turning the adjustment screw (2).





First, measure the depth (D) from the inside shoulder on the hose coupling socket to approximately halfway down the tapered area of the end of the socket. Mark off this distance from the end of the hose.

mp the hose with mandrel (4) in the vise. Use the special vise jaw caps (5) from tool box No. 5. With the adjusting ew (2) on the skiving tool, adjust the depth of cut so that the tool will take a shallow bite of the outer hose cover- (3). Using the skiving tool, remove the outer covering down to the hose wires, from the mark previously made to e end of the hose, being careful not to damage the hose wires. Then remove the hose from the vise, and pull out the andrel (4). If the skiving tool becomes dull it should be sharpened with a file. After the hose has been cut and ived, knock the end down on a work surface to loosen cutting dirt and then flush it out at the solvent wash tray. is is to prevent foreign material such as metal particles from contaminating the hydraulic system.



d. *Hose Coupling Assembly*. After the hose has been cut to the proper length and skived, the Hose Coupling Assembler may be used to attach a fitting. To operate the Hose Coupling Assembler, first perform as much of item 14 of your (B) PMCS as applies to this tool. Slide Hose Coupling Assembler out, lock in place and plug it in.

WARNING

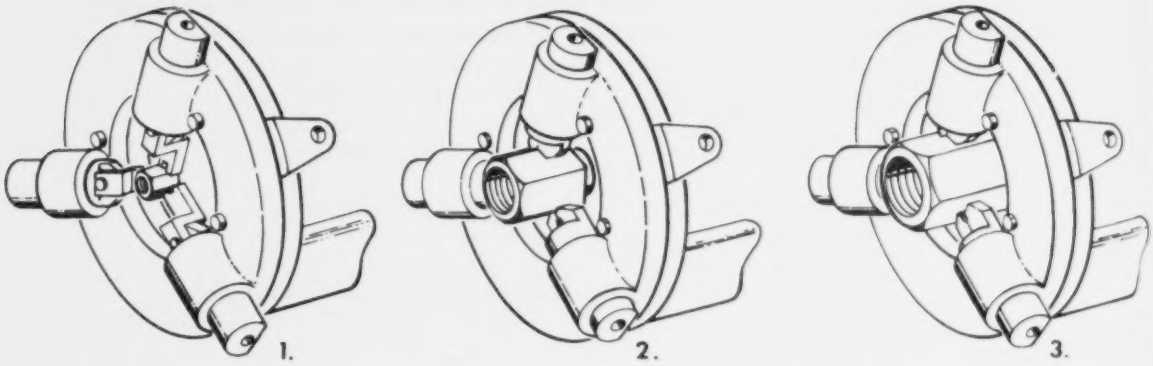
TAKE EXTREME CARE TO KEEP YOUR HANDS AWAY FROM THE MOVING PARTS OF THE HOSE COUPLING ASSEMBLER DURING OPERATION. KEEP THE GUARD IN POSITION DURING OPERATION.

DO NOT FORCE THE GUARD INTERLOCK. IT PREVENTS THE GUARD FROM OPENING EXCEPT WHEN THE SWITCH IS IN THE OFF POSITION.

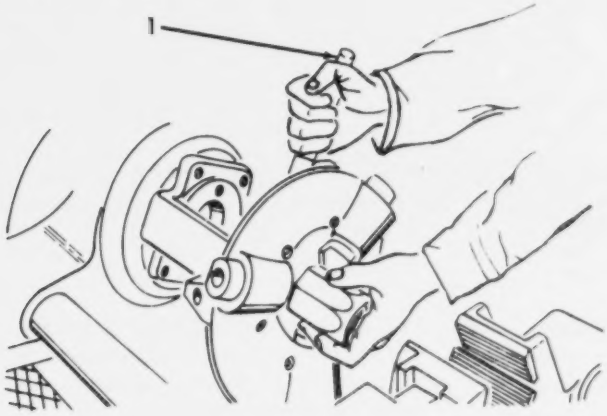
CAUTION

DO NOT REVERSE THE MOTOR WHILE THE CHUCK IS MOVING.

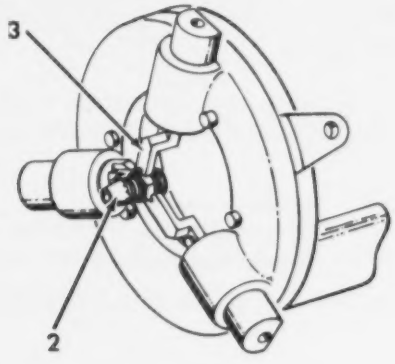
Open the guard on the hose coupling assembler, ensuring that the switch is in the off position first. Place the hose coupling socket in the jaws of the tool. Use inserts for coupling sizes 3/4" and smaller, and grip the sockets and nipples on the flats (1). For sizes 7/8" through 1½", do not use the inserts, and grip sockets and nipples on the corners (2). Grip the 2" sockets and nipples on the flats (3).



Using the soft metal chuck handle (1) which has been provided, place it in the chuck hole as shown and tighten in a clockwise direction until the socket is held firmly.



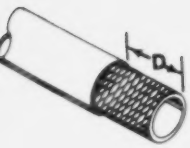
To prevent the sliding vise from feeding into chuck, if working with a small hose coupling socket (2), turn the chuck jaw inserts (3) around by removing the socket head screws. After turning the inserts around, be sure to firm by tightening the socket head screws.

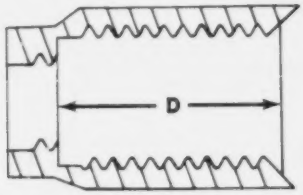


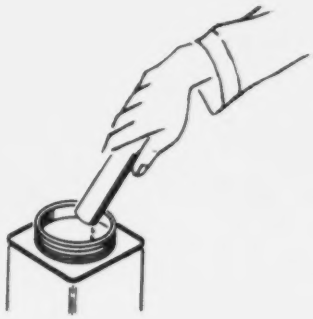
lace a mark on the outside of the hose at a distance (D) from the end, which is equal in length to the depth (D) rom the end of the socket. If the hose has been skived, the edge of the skive will serve as the mark.

CAUTION

IF THE COVER OF THE HOSE HAS BEEN REMOVED (SKIVED) DO NOT LUBRICATE THE OUTSIDE OF THE HOSE. IF YOU DO, IT WILL CAUSE THE SOCKET TO SLIP ON THE WIRE REINFORCEMENT.







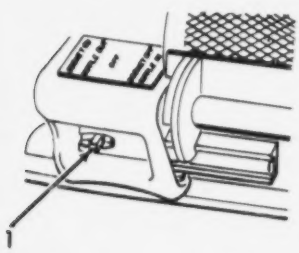
NOTE

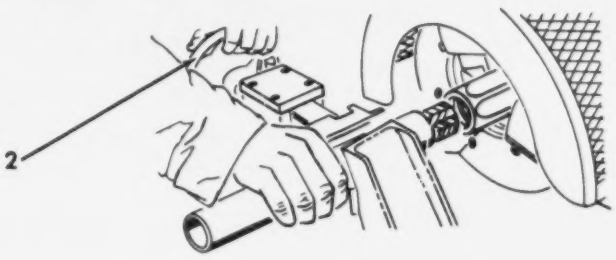
IF THE HOSE IS NO-SKIVE AND THE COUPLING IS NO-SKIVE, LUBRICATE THE HOSE BY DIPPING IT IN OE/HDO-50 OIL UP TO THE MARK.

WHEN THE EDGE OF THE SOCKET IS CLOSE TO THE MARK ON THE HOSE, RELEASE THE HAND SWITCH AND WAIT FOR THE MACHINE TO STOP TURNING. BRING THE SOCKET UP TO THE MARK ON THE HOSE BY OPERATING THE SWITCH IN SHORT INTERVALS.

BE CAREFUL NOT TO INSERT THE HOSE TOO FAR. IF THE SOCKET IS TURNED AFTER THE HOSE HAS BOTTOMED, THE HOSE WILL BE TWISTED. IF THIS SHOULD OCCUR IMMEDIATELY LOOSEN THE HANDWHEEL (2) AND ALLOW HOSE TO ROTATE.

Shut the guard and place the selector switch (1) to the "socket on" position. Clamp the hose in the sliding vise and position the hose at the fitting opening. With one hand on the wheel and one on the vise, squeeze the hand switch and advance the hose into the socket just short of the mark. When the hose is all the way in, release the hand switch, place the selector to off, and open the guard. Loosen the chuck and pull the vise and the hose away from the chuck. You are now ready to install the hose coupling nipple.



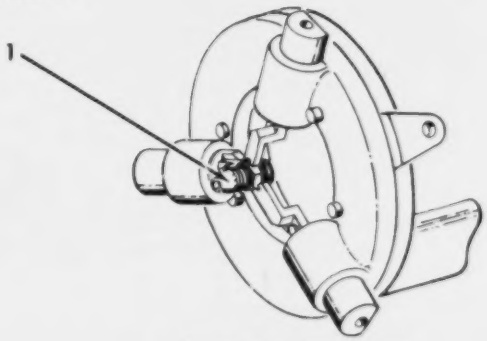


CAUTION

MAKE SURE PART OF THE NIPPLE HEX IS IN FRONT OF THE CHUCK SO THAT THE SOCKET CANNOT RUN INTO THE CHUCK.

LUBRICATE NIPPLE WITH OE/HDO-50 OIL BEFORE PUTTING IT IN THE CHUCK.

Place the nipple (1) in the chuck.



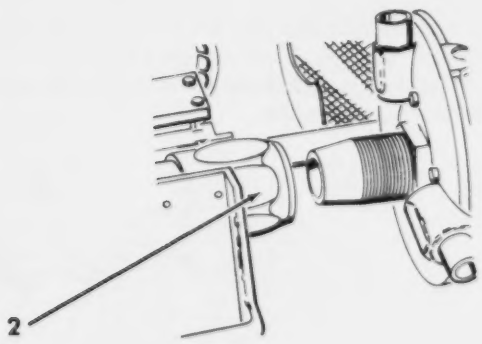
CAUTION

DO NOT BOTTOM SOCKET AGAINST NIPPLE HEX WITH POWER ON.

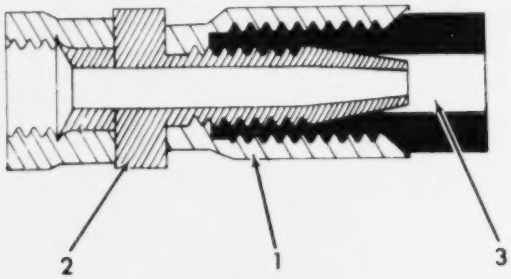
NOTE

LUBRICATE THE INSIDE OF THE HOSE BEFORE PLACING THE SOCKET WITH INSERTED HOSE IN THE VISE.

Place the socket with the inserted hose (2) in the vise and tighten the vise. Shut the guard and place the selector switch to the "Nipple In" position. With both hands on the vise, (one on wheel), squeeze the hand switch and



advance the hose onto the nipple. Avoid stopping if possible. When the edge of the socket (1) gets to the end of the thread on the nipple (2), release the switch and allow the machine to coast the remaining distance. It may be necessary to operate the switch for short intervals to bring the socket to the nipple hex edge. When finished, perform the applicable (A) portions of PMCS. Flip switch to neutral and open the guard. Loosen the chuck and the vise, and remove the hose assembly. If it is a large diameter hose, inspect I.D. of hose coupling at (3) to see if the hose liner is cut or bulged. If a coupling from a failed hose assembly is to be reused, insert the nipple hex into the chuck and tighten the chuck. Close the guard and clamp the socket into the vise. Place the switch in the "nipple out" position. Squeeze the hand switch. When the nipple has turned out of the socket release the hand switch and remove the socket from the vise. Place the selector switch in the off position, raise the guard and remove the nipple from the chuck. Put the socket in the chuck, clamp the hose in the vise, and lower the guard. Place the switch in the "socket off" position. Squeeze the hand switch and allow the socket to turn off the hose.

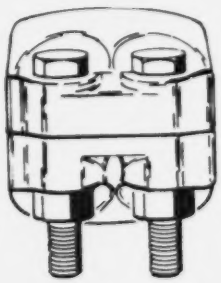


NOTE

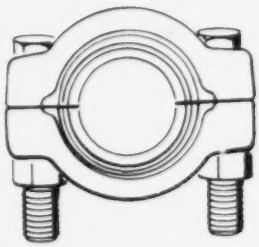
IT MAY BE NECESSARY TO PULL THE VISE, WITH THE HOSE, AWAY FROM THE TURNING SOCKET.

COUPLING MAY BE ASSEMBLED WITH A VISE AND HAND TOOLS WHEN ELECTRICAL POWER IS NOT AVAILABLE.

e. Clamp Type Coupling. Another type of hose coupling is the clamp type coupling. Skiving is not necessary with clamp type couplings.



SIDE VIEW

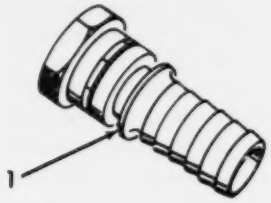


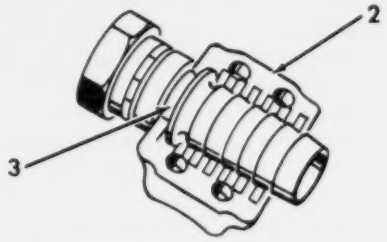
END VIEW

NOTE

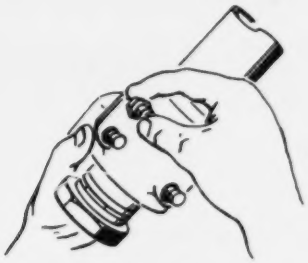
USE HAMMER, IF NECESSARY, BEING CAREFUL NOT TO DAMAGE END OF COUPLING.

To assemble a clamp type coupling lubricate the hose inside diameter and insert the nipple into the hose until it is bottomed onto the nipple collar (1).





Place Clamp halves (2) over hose with clamp front collar in nipple channel (3).



While holding clamp halves in place, drop 4 bolts through holes in clamp halves.

NOTE

IT MAY BE NECESSARY TO SQUEEZE THE CLAMPS TOGETHER USING THE VISE MOUNTED ON THE REAR DOOR.

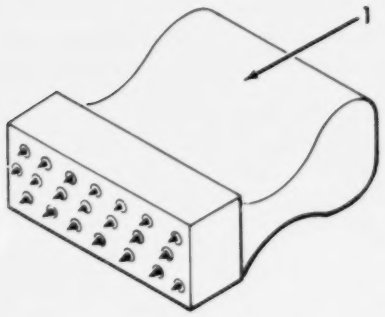
Install nuts. Turn nuts finger tight. Tighten nuts down evenly with box or open-end wrench only. Tighten nuts in accordance with the instruction sheet supplied with the hose coupling. Assembly is complete.

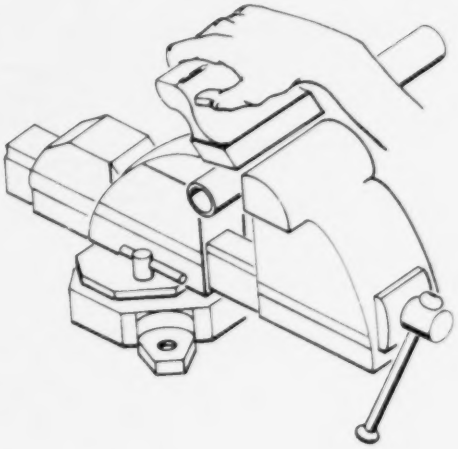
CAUTION

THE NUTS MUST BE RETIGHTENED AFTER 4-8 HOURS OF OPERATION OR THE COUPLING WILL LOOSEN AND COME OFF THE HOSE.

f. *Hose Covering Perforation.* If the hose will be carrying air, there will be a minute amount of leakage through the inner hose lining and the braid reinforcement. This may cause bubbles to form under the outer hose

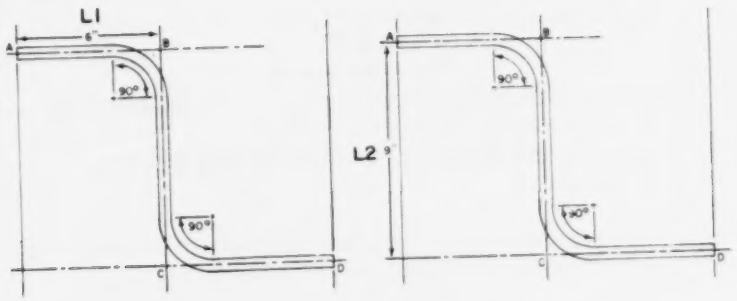
covering. For this reason it is recommended that the outer covering of an air carrying hose be perforated over its entire length to allow this minute leakage to escape. A perforation tool (1) has been provided for this purpose. Perforate only the outer covering, do not damage the braid. A spacing of approximately 1/4" between perforation is recommended.

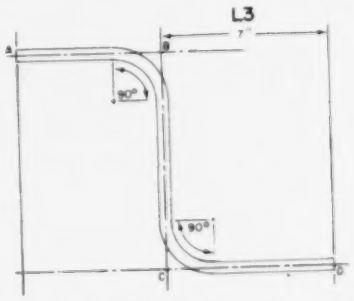




2-11. Tube Assembly Fabrication.

a. Tube Cutting. The first step in tube fabrication is to select the proper size and type of tubing. Tubing should be replaced with the same material or material which is stronger, and it must be of the same size. Tubing is measured by the outer diameter and wall thickness. The size is expressed in sixteenths of an inch. For example, -8 tubing has an outer diameter of 8/16 or 1/2 inch. To determine the correct length of tube, measure the length of each leg and add these lengths together. To this length add four extra inches. The following illustration is an example of how this should be done.



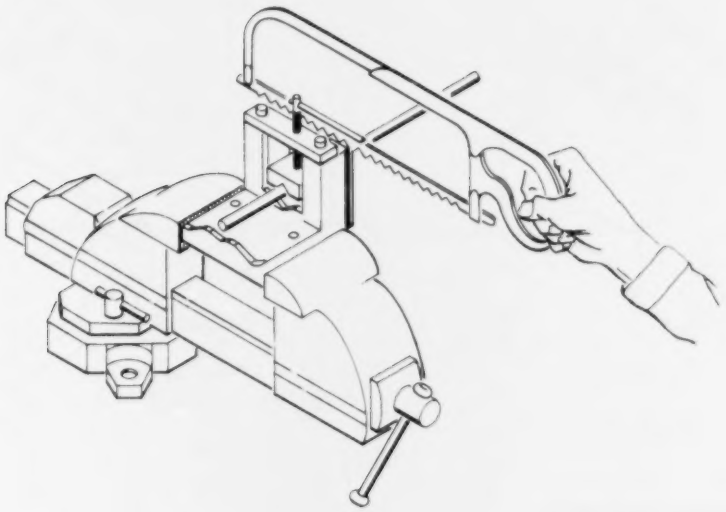


Measuring tube length required.
Length required is L_1 plus L_2 plus L_3.

Example:

L_1 = 6 inches
L_2 = 9 inches
L_3 = 7 inches
TOTAL = 22 inches
and add 4 extra inches.

Mark off this distance on the tubing. Place the cross cut vise in the machinist vise and then clamp the tube in the cross cut vise. Use the hacksaw to cut the tube, sawing slowly with light, even pressure to ensure a smooth, even cut. Use a fine file to dress the end smooth and square.



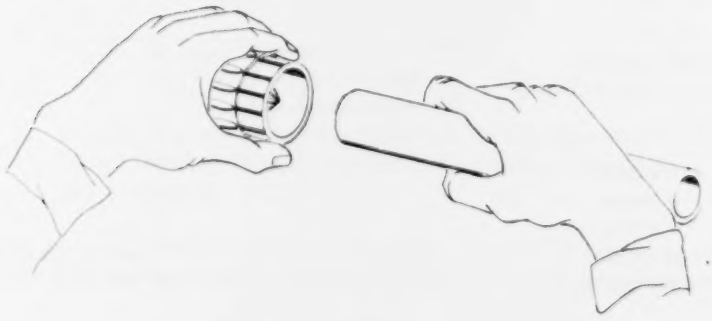
CAUTION

WHEN USING THE CROSSCUT VISE TO HOLD HYDRAULIC SYSTEM TUBING FOR CUTTING, BE SURE NOT TO SCORE OR SCRATCH THE TUBING WITH THE JAW OF THE VISE.

NOTE

STOCK HELD IN THE VISE FOR WHATEVER REASON MUST BE HELD FIRMLY ENOUGH TO PERMIT TASK COMPLETION, BUT NOT SO FIRMLY AS TO CRUSH OR DAMAGE THE MATERIAL.

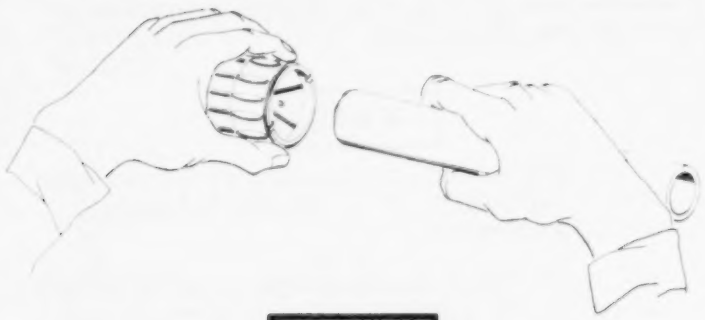
b. *Tube Deburring*. The deburring tool is a simple, hand operated tool. To use it, simply insert it in the end of the tube to be deburred and twist it until the interior burrs are removed.



NOTE

DEBURR ONLY ENOUGH TO REMOVE ROUGH EDGES. DO NOT CHAMFER, OR BEVEL THE END OF THE TUBE.

To remove outside burrs, turn the tool around, insert the tube into the tool, and twist the tool until the burrs are removed. Flush the tube out at the solvent wash station and inspect to be sure that all chips are removed.



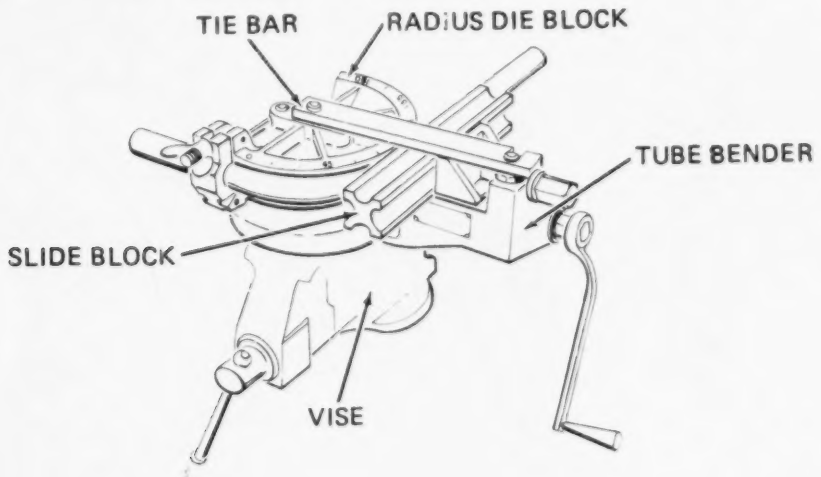
NOTE

THE BLADES ARE REMOVABLE FOR SHARPENING.

FLARE ONE END OF THE TUBE PRIOR TO BENDING IF FLARE TYPE FITTINGS ARE TO BE USED.

c. Tube Bending. A tube bender is provided in the HSTRU (see figure 2-4). It can be used to bend stainless steel tubing from 1/4 inch outside diameter (O.D.) through 1 inch O.D. It can be used to bend aluminum and annealed carbon steel tubing from 1/4 inch O.D. through 1-1/4 inch O.D. If used properly, the tube bender produces accurate bends without wrinkling or flattening the tubing. Setup of the bender for any size tube is quickly and readily accomplished as follows:

(1) The bender should be mounted in the bench vise as shown.



(2) Select the radius die block (1) to suit tube size. (Outside diameter of tube determines radius block size).

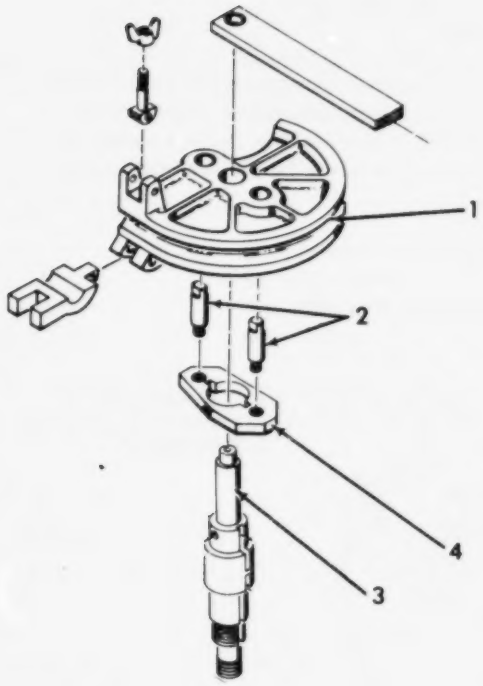
(3) Radius blocks, size 1/4 inch through 3/4 inch, are made to drive with two pins (2): radius blocks, 7/8 inches through 1-1/4 inches, are made with a three pin drive. After selecting the proper size radius block (1) remove or add one drive pin (2) in the drive plate (4) to correspond with the radius block.

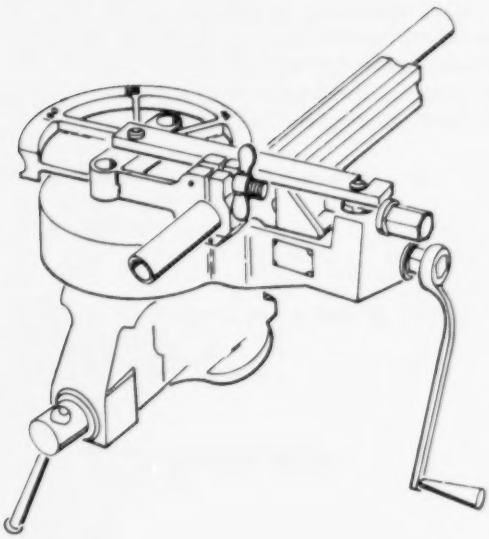
(4) Mount the selected radius block on center post (3) and position it so the 0° mark is toward the handle end of the bender. Radius blocks are accurately milled and bored, to slip easily onto posts.

NOTE

WHEN HANDLING RADIUS DIE BLOCKS, AS WELL AS SLIDE BLOCKS, USE CARE TO AVOID NICKING OR DAMAGING GROOVED SURFACES.

THE CENTER PIN (3) IS LARGER THAN THE DRIVE PIN (2) AND SHOULD BE MATCHED TO THE APPROPRIATE HOLE IN THE RADIUS BLOCK.

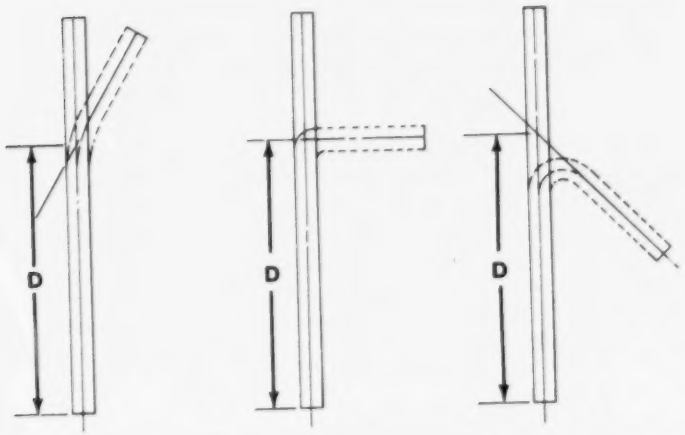




(5) Next, determine the distance (D) from the end of the tube to the first bend. This is measured from the open end of the tube straight down the center, extending out of the bent part, to the point where it intersects with a similar straight line which extends through the centerline of the straight portion which follows the bend. Mark off this distance on the tube.

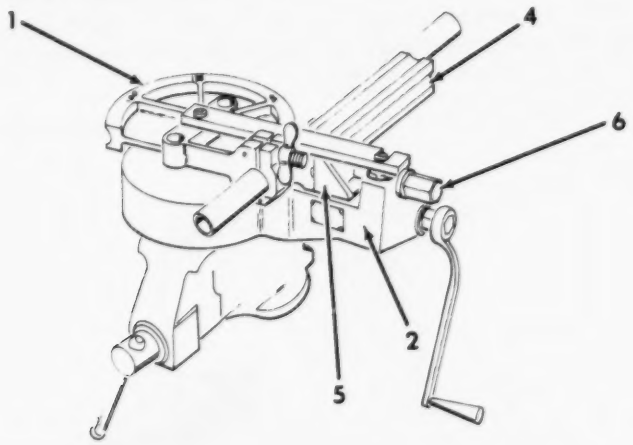
CAUTION

DO NOT USE A SCRIBE OR SHARP TOOL TO MARK TUBING. THIS WILL CREATE A STRESS POINT AND POTENTIAL FAILURE.



(6) Select proper slide block (4) with groove to suit outside diameter of tube. Lubricate the face of the vise plate with OE.

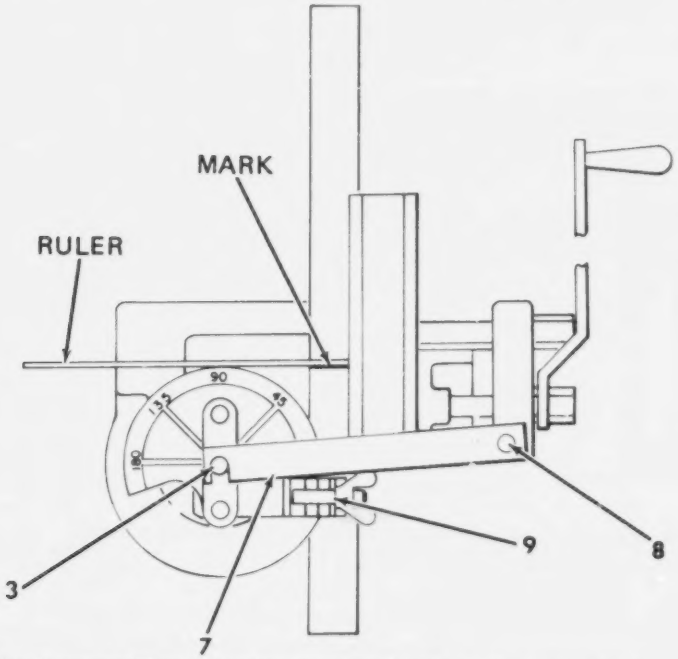
(7) Place slide block (4) on bender frame (2) between vise plate (5) and radius block (1), and position with left edge of slide block in line with edge of bender frame. Advance slide block by moving vise plate (5) with telescopic adjusting screw (6), until it is approximately 1/16 inch from the radius die block (1).



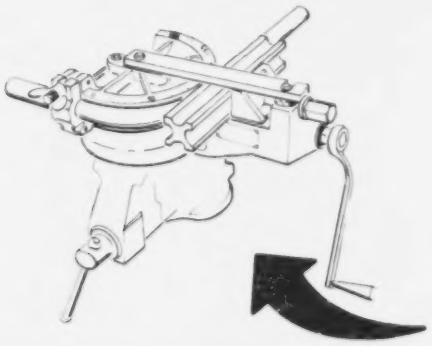
(8) With the radius die block positioned at 0^{o}, slide the tube through between the radius die block and the slide block, and through the clamp (9) on the radius die block. Tighten the adjusting screw until the slide block rests against the tube firmly but not with so much pressure as to prevent movement.

(9) Position the 6" rule against the radius die block at the mark corresponding to the desired angle of bend and perpendicular (square) to the slide block. Adjust the tube so that the mark on the tube is under the edge of the ruler. Tighten the tube clamp (9) on the radius die block.

(10) Place the tie bar (7) over the center post (3) and the dowel pin (8).



(11) Bending is accomplished by turning the crank handle on the worm wheel drive shaft connection. The worm gear mechanism reduces the effort required from the operator and the tube is easily bent to the desired angle. As the bend is being made, the slide block travels with the tube and bears lightly against the radius die block to provide a circular die enclosing the tube. This action forms a smooth, full cross-section bend.



The angle of bend is indicated by the marks on the radius block. When the pressure is released, the tubing will tend to spring back slightly toward its original shape. To compensate for this it is recommended that the tube be bent a little beyond the desired bend, about 3^{o} for a 90^{o} bend, a little more or less for other bends.

NOTE

ON LONG LENGTHS OF TUBING, PROVIDE SUPPORT TO PREVENT SAG AND HELP KEEP TUBING ALIGNED WITH RADIUS BLOCK CENTERLINE.

IF TUBING IS BEING BENT TO FIT IT IS BEST TO BEND IT A LITTLE AT FIRST AND CHECK FOR CORRECT FIT, THEN BEND A LITTLE MORE EACH TIME UNTIL A CORRECT FIT IS OBTAINED.

IF THERE WILL BE SEVERAL BENDS MADE ON THE SAME TUBE, A THIN, STRAIGHT LINE SHOULD BE DRAWN FROM END TO END. THIS LINE MAY THEN BE USED AS A HANDY REFERENCE TO MAINTAIN ACCURATE LOCATION. ALSO THE TUBE SHOULD BE FED THROUGH THE BENDER SUCCESSIVELY IN THE SAME DIRECTION AS EACH BEND IS MADE. THIS WILL AUTOMATICALLY COMPENSATE FOR THE TENDENCY OF THE TUBING TO STRETCH AS IT IS BENT.

(12) At completion of bend, retract vise plate which permits removal of slide block.

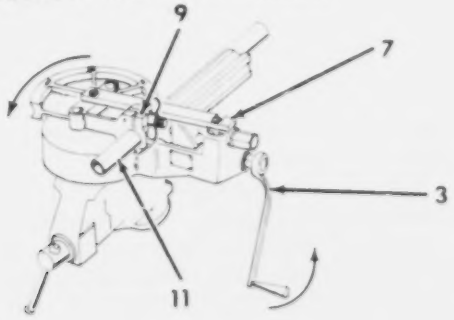
(13) In removing the bent tube the tie bar (7) must be removed. Replace the bar before proceeding with the next bend.

(14) Loosen clamp device (9) and remove bent tube (11).

(15) Turn worm wheel shaft (3) counterclockwise to disengage. Turn radius block back until 0^{o} mark is at original starting point. Bender is ready for the next bend.

NOTE

ALWAYS MAKE BENDS FROM LEFT TO RIGHT.



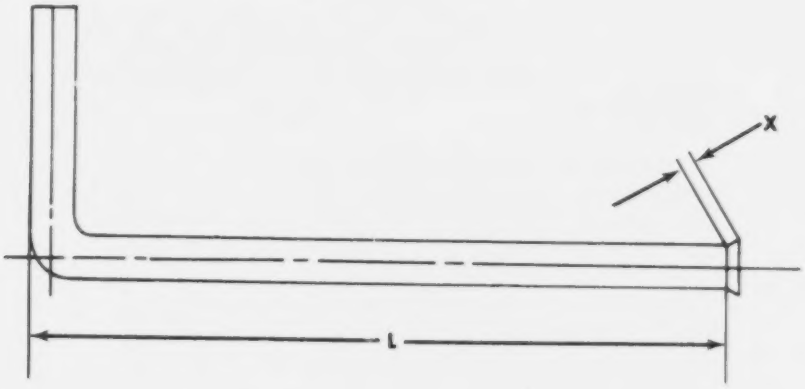
NOTE

TURN WORM WHEEL SHAFT IN CLOCKWISE DIRECTION AND PUSH IN TO RE-ENGAGE GEAR AT START OF NEXT BEND.

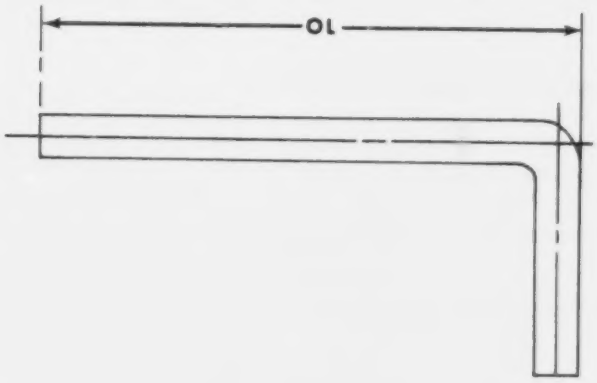
After all bends have been completed, cut the tube to the required length in the following manner.

(1) Measure the length (L) to the edge of the flare on the old tube.

(2) Measure the length (x) of the flare surface on the old tube.



(3) Add the lengths together and mark this length (OL) on the new tube, and cut the tube.



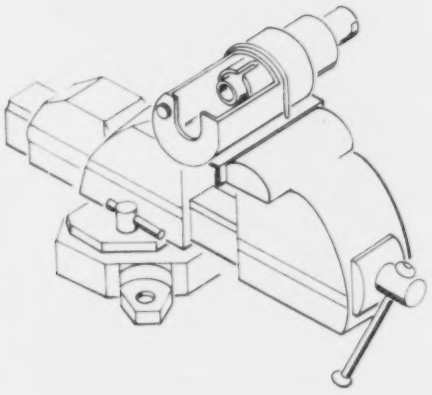
d. Flaring Procedure.

NOTE

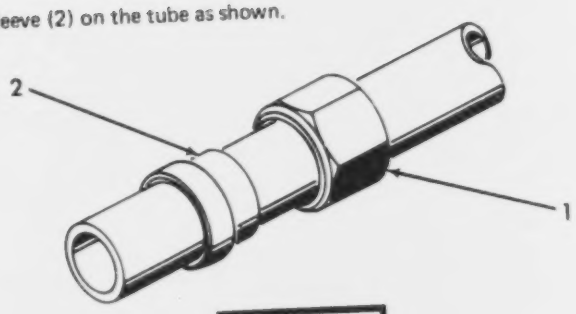
THIS TOOL PRODUCES A SINGLE FLARE. SINGLE FLARE TUBE ASSEMBLIES WHEN FABRICATED WITH THE MATERIAL ON BOARD THE HSTRU CAN BE USED IN PLACE OF DOUBLE FLARE TUBE ASSEMBLIES UP TO 3000 PSI.

nsure that the tube end has been properly prepared. Tube end should be cut squared, filed smooth, deburred, and ee of foreign matter.

Place the flaring tool in the machinist's vise facing operator. Connect the tool to the hand pump (see item 11, PMCS).



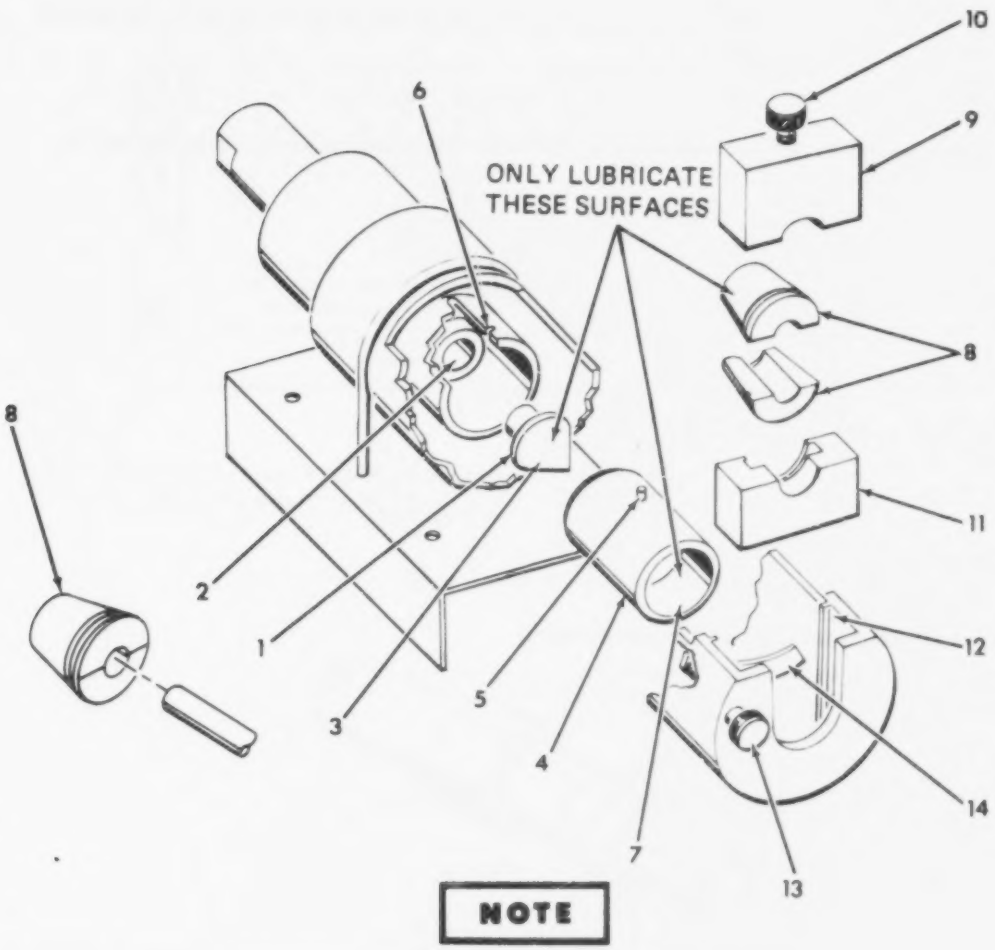
Place the nut (1) and the sleeve (2) on the tube as shown.



NOTE

DO NOT OPERATE THE FLARER WITHOUT LUBRICATING THE INSIDE OF THE DIE RING AND THE OUTSIDE TAPERED SURFACES OF THE DIE SET. THESE SURFACES MUST BE KEPT CLEAN AND WELL LUBRICATED FOR PROPER FUNCTIONING OF THE TOOL. DO NOT ALLOW LUBRICANT IN I.D. OF DIE (TUBING GROOVE). IF THIS OCCURS ACCIDENTALLY, WASH AND START PROCEDURE AGAIN.

Wash the flaring cone (1) with solvent to remove any preservative. Dry. Lubricate the tapered flaring face (3) of the cone (1) with LSA oil. Insert flaring cone into ram hole (2). Lubricate tapered die seat area (7), install the die ring (4) and rotate the lock pin (5) into slot (6). Select proper size die set by matching die halves (8) to the tube O.D. Wash the die set in solvent to remove any preservative. Dry carefully. Attach upper half of die in upper half of die retainer assembly (9) by means of the screw thread on the knob pin (10). The upper half of the die set has a threaded hole for this purpose. Lubricate outside tapered surfaces of both halves of die set (8) with LSA oil. Place the lower half of die set (8) in tongue-and-groove engagement with lower half of die retainer (11) and drop into tool slot (12).



NOTE

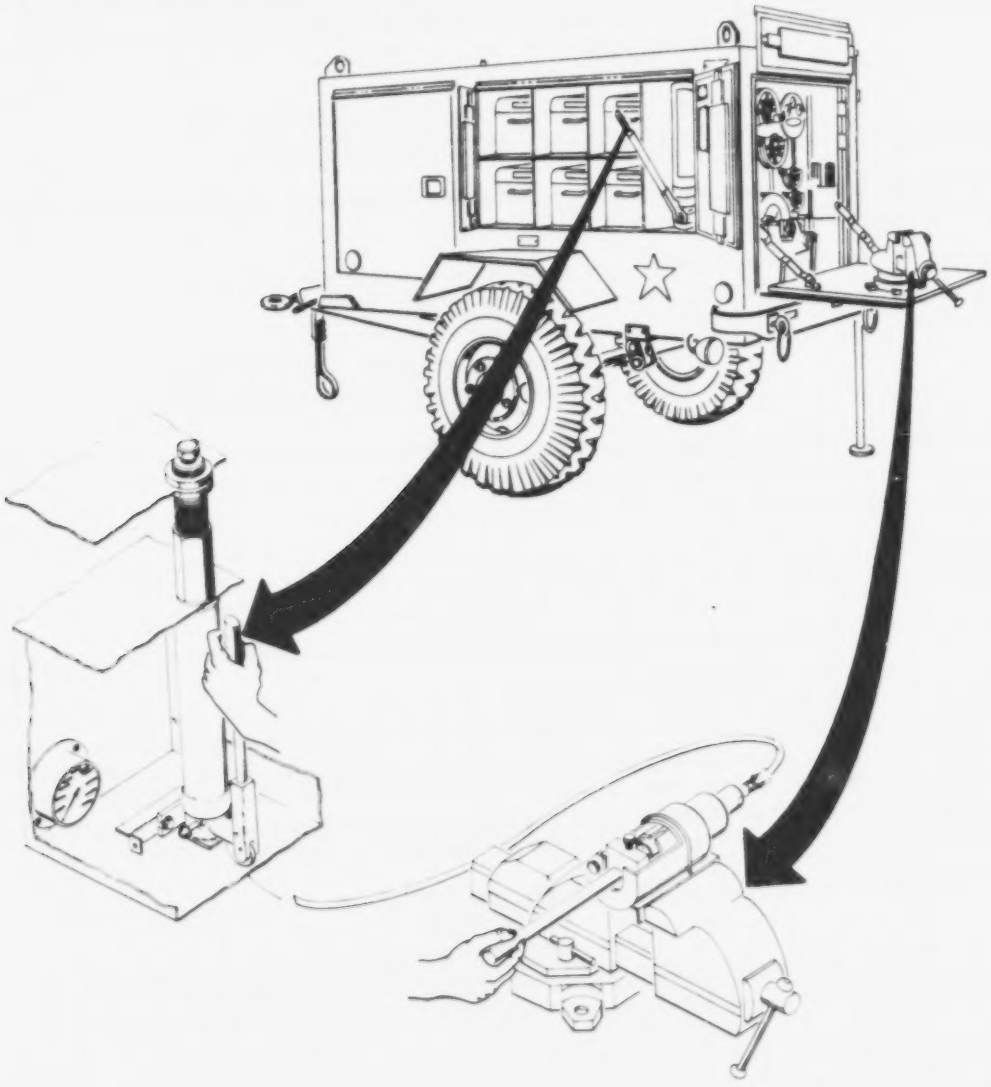
DO NOT ALLOW LUBRICANT ON INSIDE SURFACE OF DIE SET.

Place the tube on the lower die half and place the upper die retainer with die attached into the tool slot over the tube. Move the tube stop knob (13) to raise the tube stop (14) into the "up" position, pull back against the end of the dies, and push the tube into the tool until it contacts the tube stop. Release the tube stop knob and ensure that the stop returns to its "down" position.

NOTE

MAKE SURE THAT THE NUT AND SLEEVE HAVE BEEN INSTALLED.

Hold the tube in position while advancing the ram until the die ring engages the dies. The dies will then clamp and hold the tube while the flaring cone advances forming the flare.



CAUTION

HYDRAULIC PRESSURE USED TO ACTUATE THE FLARING TOOL MUST NOT EXCEED 7000 PSI. GENERALLY, EXCESSIVE PRESSURE IS TO BE AVOIDED IN FLARING SMALL DIAMETERS, THIN WALLS OR SOFT MATERIALS AS FLARE DISTORTION WOULD RESULT. OPTIMUM RESULTS AND TOOL SERVICE LIFE ARE ATTAINED IF FLARING PRESSURES ARE HELD TO MINIMUM REQUIRED TO COMPLETE FLARING.

BE SURE THAT THE LEADING EDGE OF THE DIE RING DOES NOT PREVENT TRAVEL OF THE DIE SET.

While the flare is being formed, the pressure guage will show a rapid pressure rise as the flaring cone is forced solidly against the tube flare.

NOTE

A TABLE SHOWING RECOMMENDED FLARING PRESSURES IS MOUNTED ON THE HAND PUMP COMPARTMENT DOOR.

Table 2-3 is a guide to pressure requirements for various tube sizes, wall thicknesses and materials. This table also shows the minimum length of straight tubing to the start of the bend radius which is required if the tube is to be flared after bending.

NOTE

FLARE ONE END OF THE TUBE PRIOR TO MAKING THE FIRST BEND.

Continue pumping until the required pressure has been reached. Then open the bypass valve on the pump. Observe that the pressure drops to zero and the flaring cone retracts. The tubing may now be removed from the tool. Inspect the flared portion of the tube very closely for quality. The outside edge of the flare should be evenly formed. It should fall between the OD and ID of the sleeve's toe. The internal surface should be perfectly smooth and uniform and free of flaws. Refer to figure 2-12. Only example 1 is acceptable.

NOTE

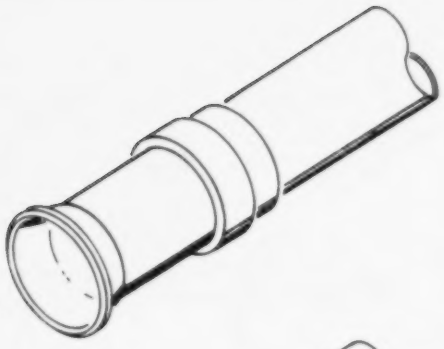
THE FLARING CONE AND DIE SET SHOULD BE RE-COATED WITH PRESERVATIVE BEFORE THEY ARE RE-STOWED.

Table 2-3. Recommended Flaring Pressures.

SIZE	WALL	.035	.049	.065	.083	.095	.109	.120	.134	MINIMUM STRAIGHT LENGTH TO START OF BEND
4	SS	400	700	1100						2-1/16
	STEEL	300	500	800						
	COPPER	150	200	350						
	& ALUM	150	200	350						
5	SS	500	800	1300						2-1/16
	STEEL	400	600	1000						
	COPPER	150	250	400						
	& ALUM	150	250	400						
6	SS	600	900	1500						2-1/8
	STEEL	500	700	1100						
	COPPER	200	300	500						
	& ALUM	200	300	500						
8	SS	800	1200	2000	2500					2-3/16
	STEEL	600	900	1500	1900					
	COPPER	250	350	600	750					
	& ALUM	250	350	600	750					
10	SS	900	2000	2500	2800	3000				2-5/16
	STEEL	680	1500	1900	2100	2300				
	COPPER	275	600	750	800	900				
	& ALUM	275	600	750	800	900				
12	SS	1000	1700	2500	3100	3500	4000			2-5/16
	STEEL	750	1300	1900	2300	2700	3000			
	COPPER	300	500	750	900	1100	1200			
	& ALUM	300	500	750	900	1100	1200			
14	SS		1500	2400	3000	3400	4200			2-7/16
	STEEL		1100	1800	2300	2600	3200			
	COPPER		500	700	900	1000	1300			
	& ALUM		500	700	900	1000	1300			

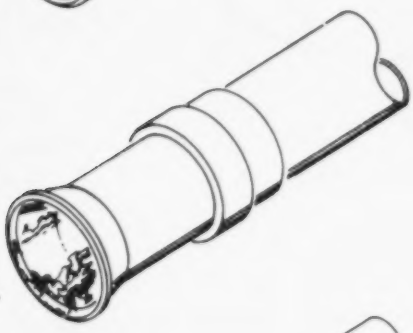
Table 2-3. Recommended Flaring Pressures (Continued).

SIZE	WALL	.035	.049	.065	.083	.095	.109	.120	.134	MINIMUM STRAIGHT LENGTH TO START OF BEND
16	SS			2400	3000	3400	4200	4800		
	STEEL			1800	2300	2600	3200	3600		
	COPPER			700	900	1000	1300	1400		2-7/16
	& ALUM			700	900	1000	1300	1400		
20	SS			2800	3400	4000	4800	5300		
	STEEL			2100	2600	3000	3600	4000		
	COPPER			800	1000	1200	1400	1600		3-3/16
	& ALUM			800	1000	1200	1400	1600		
24	SS				4000	4500	5300	5800		
	STEEL				3000	3400	4000	4400		
	COPPER				1200	1300	1600	1700		2-7/8
	& ALUM				1200	1300	1600	1700		
32	SS					3300	4000	5000	6300	
	STEEL					2500	3000	3800	4700	
	COPPER					1000	1200	1500	1900	3-9/16
	& ALUM					1000	1200	1500	1900	
	CAUTION DO NOT EXCEED 7000 PSI									

1. 

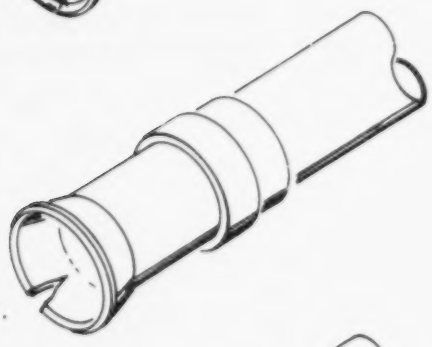
PASS

Cause N/A

2. 

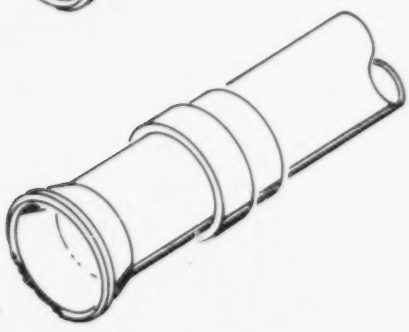
FAIL

Cause Improper Cleaning

3. 

FAIL

Cause Opened scratch or improper tube selection

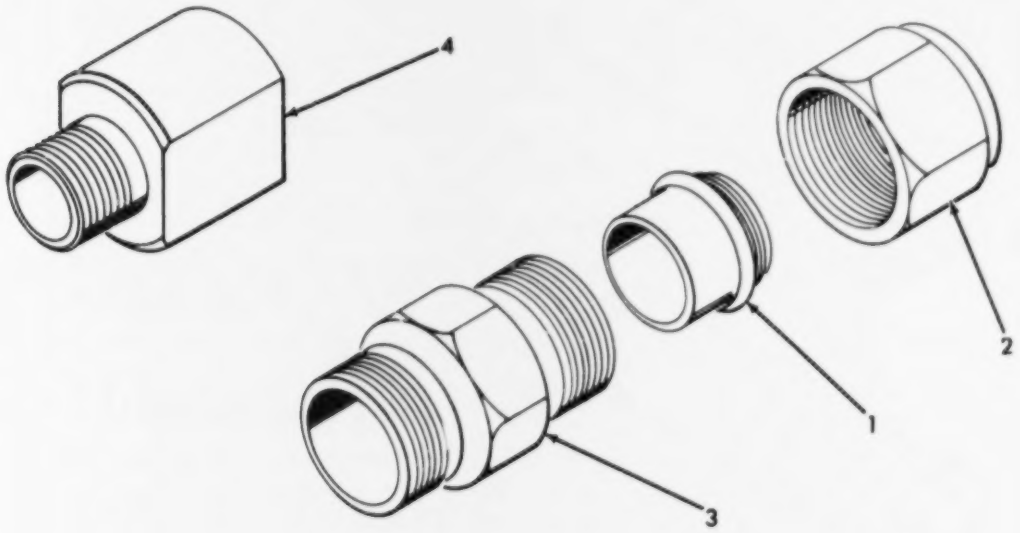
4. 

FAIL

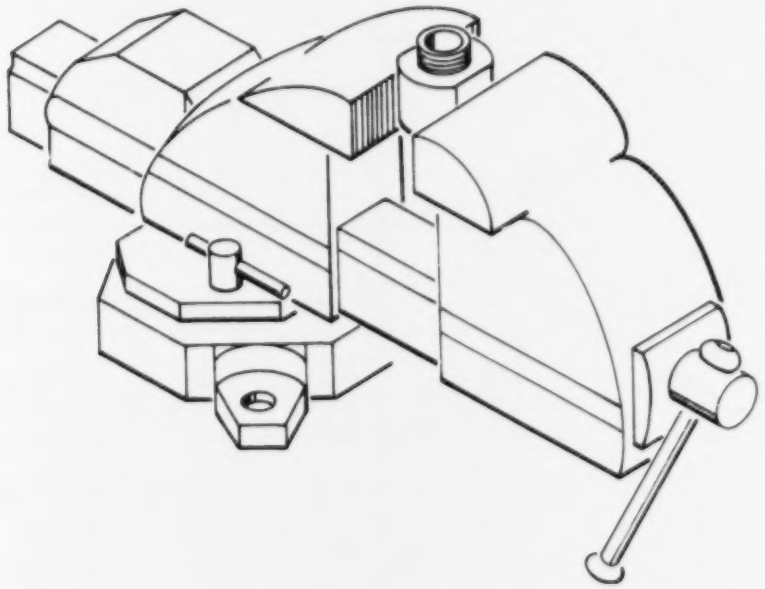
Cause Improper deburring

Figure 2-12. Flaring Examples.

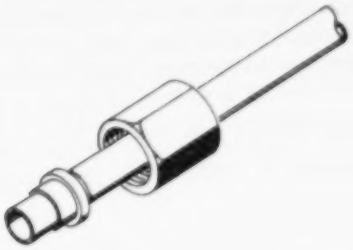
e. *Bite-Type Fittings.* The bite-type fitting consists of a ferrule (1), a nut (2), and a fitting body (3). It does not use a flare. Instead it uses a special sleeve which bites into the outer surface of the tubing to seal and grip the tubing. The bite must be preset in a short preliminary operation. A presetting tool (4) has been provided for this purpose.



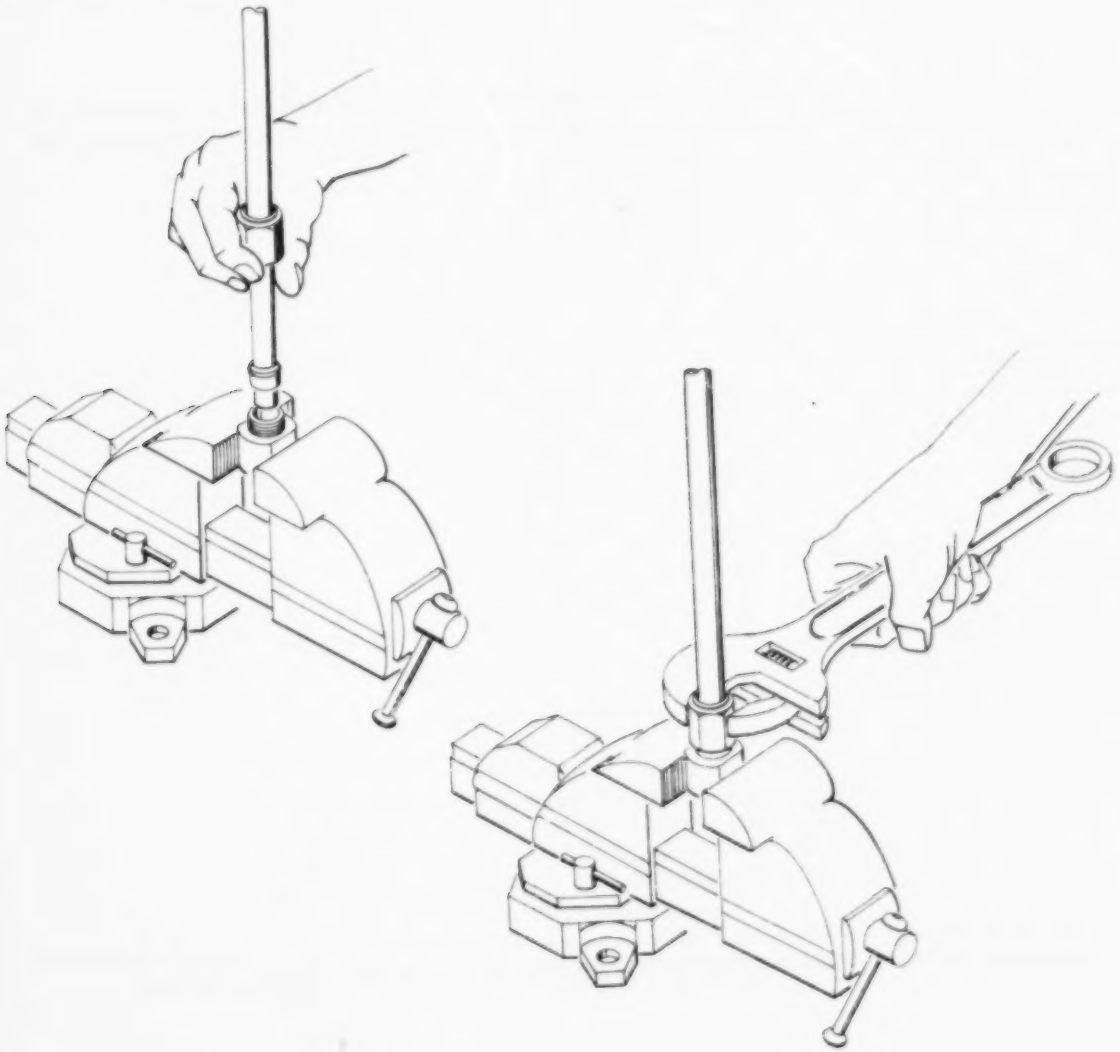
Each presetting tool is marked for the size tubing it is to be used with. Select the correct size tool and place it in the vise. If the tool is not available, the fitting body may be used. The tool is recommended because it is made of a harder material. Lubricate the tool thread thoroughly with LSA oil.



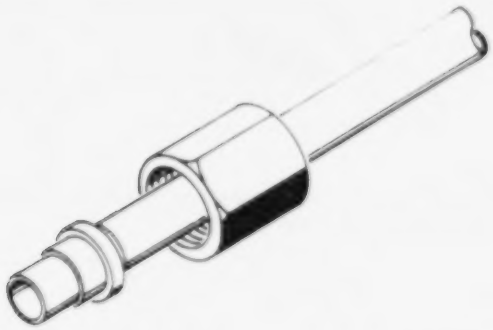
a nut on the tubing with the open, threaded end facing toward the end of the tube. Place a ferrule on the tube that the long portion is facing the end of the tubing. Thoroughly lubricate the ferrule.



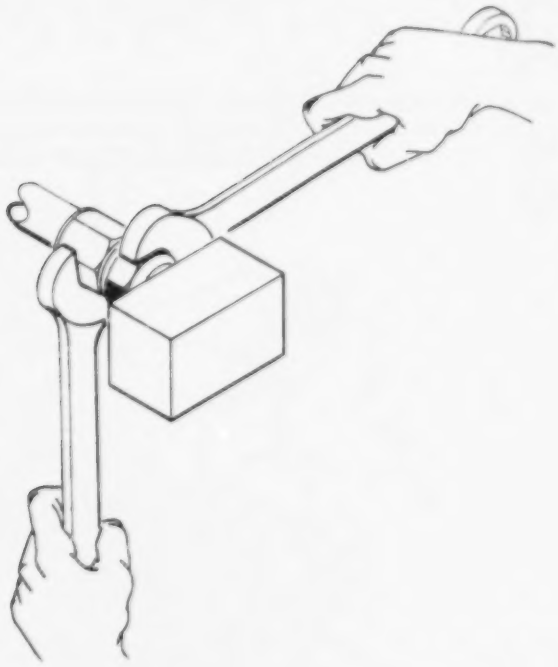
nsert the tubing in the presetting tool. Be sure that it is seated on the shoulder, in the tool. Screw the nut down ntil it is finger tight, then turn an additional 1-3/4 turns.



Back the nut off and inspect the quality of the bite. Be sure that the sleeve has taken a bite all the way around the tube. The raised edge of metal from the tube should cover half the thickness of the leading edge of the ferrule. The curved leading portion of the ferrule should have been partly flattened. The rear portion of the ferrule should have a grip on the tube. The ferrule may rotate, but should not move back and forth. The leading edge of the tube should have the imprint of the tool shoulder around its circumference. Wash the LSA lubricant off with solvent.

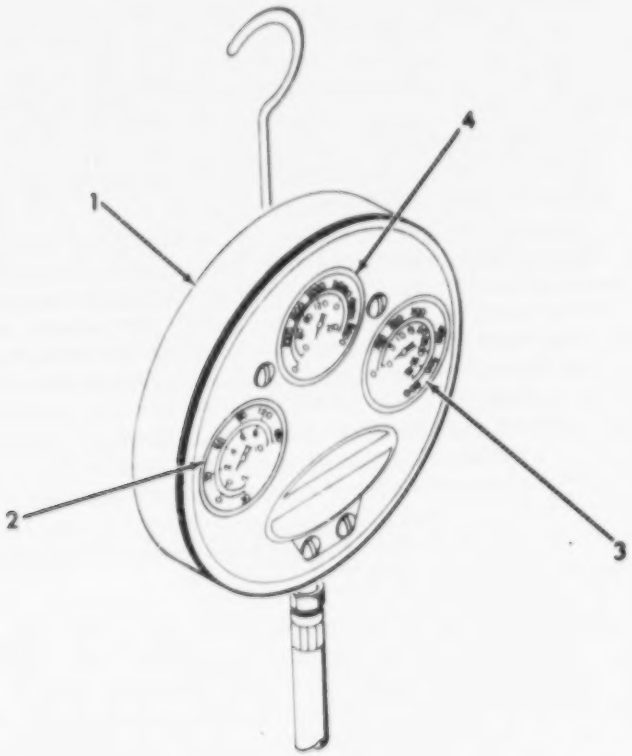


To install the tubing in the equipment, coat the threads with MIL-L-2104 or equivalent. Then thread the fitting body into the threaded hole provided and tighten. Place the end of the tube into the body until it contacts the shoulder.



Screw the nut on, using a wrench, until a resistance is felt, then tighten an additional 1/6 turn. It is recommended that a second wrench be used here to hold the fitting body stationary while the nut is being tightened.

-12. **Multi-Range Pressure Gage.** The multi-range pressure gage (1) is capable of measuring both pressure and acuum. It has three gages in the same housing. The left hand gage is a low pressure and vacuum gage (2). You vill notice that the pointer (needle) points to zero ("0") when the gage is not in use. The low pressure gage has a alve in it which automatically shuts it off if the pressure being read exceeds 100-150 PSI. When that happens, you nay read the pressure on the right hand gage. The right hand gage is a mid-range pressure gage (3) which can read pressures up to 600 PSI. This gage has an internal valve which will shut it off if the pressure becomes greater than 500-600 PSI. The center gage is a high range pressure gage (4). It is capable of reading pressures up to 5000 PSI. It s not necessary to switch from one gage to another. All gages will begin to read as soon as pressure is applied and will continue to read until the pressure causes them to shut off. Shut off is automatic so that the gages will not be damaged by excess pressure.



NOTE

ALWAYS READ THE PRESSURE ON THE HIGHEST GAGE. FOR EXAMPLE, 350 PSI SHOULD BE READ ON THE RIGHT HAND GAGE. THE LEFT HAND WILL WILL SHOW A READING BETWEEN 100-150 PSI. NONE OF THE GAGES WILL RETURN TO 0 UNTIL THE PRESSURE IS RELEASED.

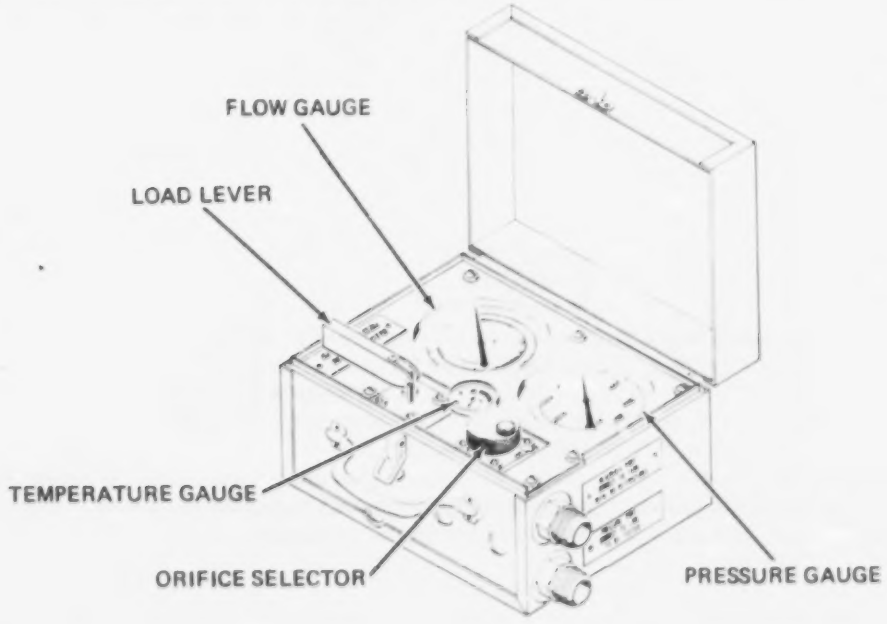
SCALE CALIBRATIONS IN BOTH METRIC AND ENGLISH MEASURING SYSTEMS ARE PRINTED ON THE GAGE FACES.

2-13. Hydraulic System Tester. The hydraulic system tester permits you to test hydraulic system components by measuring fluid flow (GPM), pressure (PSI), and temperature (^{O}F). With this tester, pumps, valves, cylinders, and other hydraulic system components can be checked at their rated pressures and flows. If you understand how hydraulic systems work and you are using the technical data for the system which you are testing, then you can use this tester to pinpoint most areas of hydraulic malfunction without guessing.

WARNING

WHEN USING THE TESTER LOAD VALVE, DO NOT OPERATE THE SYSTEM FOR MORE THAN 10-20 SECONDS AT A TIME AS THIS WILL CAUSE THE SYSTEM OIL AND THE TESTER TO OVERHEAT. DO NOT OPERATE THE SYSTEM AT RELIEF SETTING FOR MORE THAN 10-20 SECONDS AS THIS WILL CAUSE THE RELIEF VALVE TO OVERHEAT. WATCH THE TEMPERATURE GAGE. IF THE TEMPERATURE REACHES 100^{O}F OVER AMBIENT, ALLOW THE SYSTEM TO COOL BEFORE CONTINUING.

a. Hydraulic Power. Using hydraulic power to accomplish work is possible if both flow and pressure exist in a hydraulic system. A hydraulic system can do work when seals are good, components are not worn, tolerances are as specified relief valves are operating properly, and when the equipment is being operated within its design capability. In a hydraulic system, the pump produces flow and pressure. Internal wear in a pump permits slippage or bypassing of the oil by the gears, vanes, or pistons and results in the pump not being able to deliver the rated volume of oil under pressure. When flow and/or pressure is reduced, hydraulic power is reduced. Cylinders and valves function when flow and pressure are received. Leakage in valves reduces working flows delivered downstream of the valve. The thing to consider in hydraulic system analysis is, if at any point in the test, there is a loss of flow shown on the tester at system operating RPM, temperature and pressure, hydraulic oil is leaking past one of the components receiving flow and pressure. By following the fault isloation procedure shown in the applicable technical manual on the piece of equipment that is not working properly, any fault can be located. If the equipment TM is not adequate, perform the "tee test" described in paragraph 2-13e.



b. *Relief Valves.* Hydraulic systems are protected from excessive pressure by relief valves. An improper relief valve setting endangers the system with too much pressure or permits bypass of flow prior to development of the maximum specified system pressure.

WARNING

BE SURE RELIEF VALVES ARE PROPERLY ADJUSTED. THIS PRESSURE MUST BE OBTAINED FROM THE TM OF THE PIECE OF EQUIPMENT THAT NEEDS REPAIR. IF THIS PRESSURE IS NOT KNOWN, DO NOT ATTEMPT TO TROUBLESHOOT.

c. *Before Starting Equipment.*

WARNING

BE SURE TO KEEP LOAD PRESSURES WITHIN TESTER AND SYSTEM RATINGS. DO NOT EXCEED LISTED RELIEF VALVE PRESSURE OF THE SYSTEM WHEN TESTING.

CONNECT THE TESTER CORRECTLY. WHEN A HIGH PRESSURE LINE IS CONNECTED TO THE EXIT PORT (LOW PRESSURE RETURN SIDE) OF THE TESTER, BACK PRESSURE OCCURS. THE BLOWOUT PLUG RELEASES FLUID IN THE TESTER CASE WHEN THE BACK PRESSURE REACHES 3000-3500 PSI.

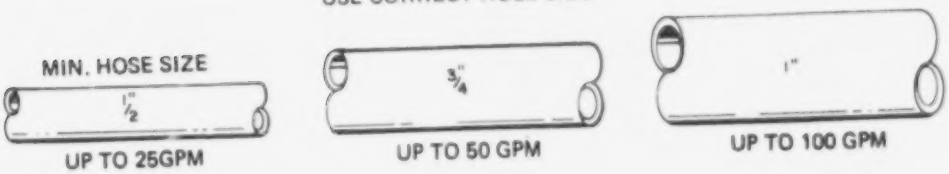
CAUTION

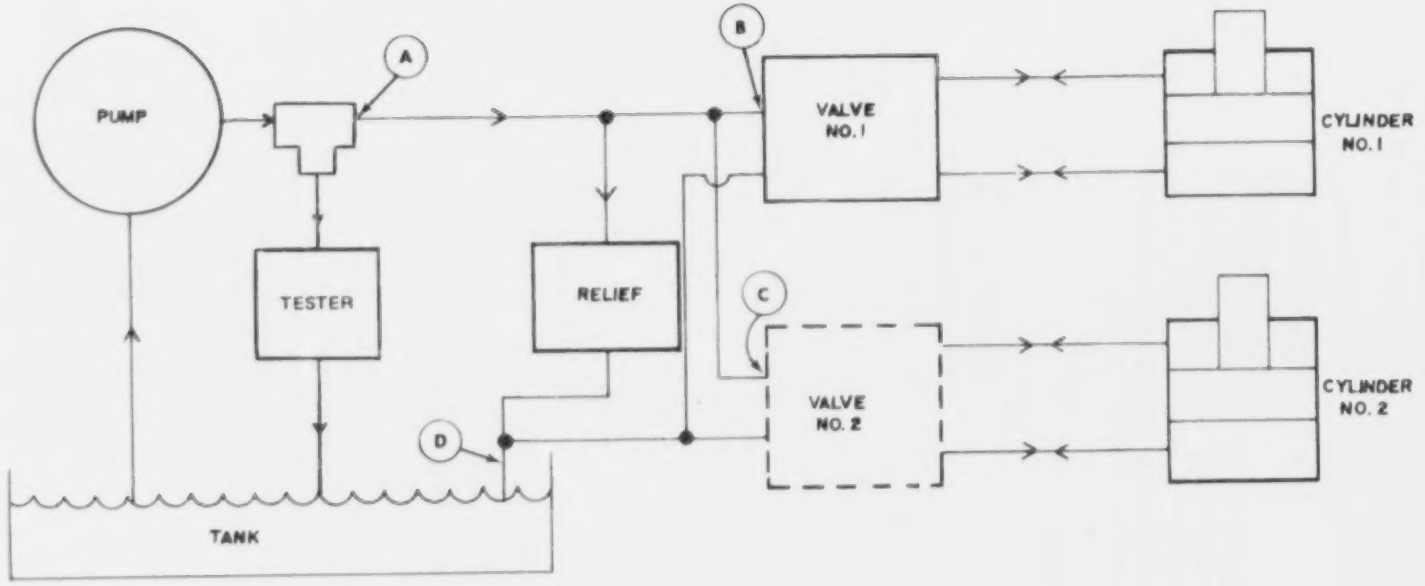
CHECK THE TECHNICAL DATA RELATING TO THE SYSTEM WHICH YOU ARE TESTING AND FIND OUT WHAT ITS RATINGS ARE. CHECK MAXIMUM PUMP SPEED (RPM), FLOW, SYSTEM PRESSURE, AND OPERATING TEMPERATURE. DO NOT EXCEED THESE RATED MAXIMUMS.

THE LOW PRESSURE RETURN LINE MUST BE AS LARGE OR LARGER THAN HIGH PRESSURE AND AS SHORT AS POSSIBLE. BACK PRESSURE MUST NOT EXCEED 100 PSI. INTRODUCE ONLY PETROLEUM BASE HYDRAULIC (MIL-L-2104 or MIL-H-5606) FLUID INTO UNIT.

NOTE

USE CORRECT HOSE SIZE





NOTE

THIS ANALYSIS IS COMMONLY REFERRED TO AS A "TEE" TEST — USE OF A TEE FITTING TO HOOK THE HYDRAULIC SYSTEMS TESTER INTO THE HYDRAULIC CIRCUIT OF THE EQUIPMENT UNDER TEST.

Figure 2-13. Analysis of a Typical Equipment Hydraulic Circuit.

hydraulic systems are made up basically of the same components. To test the components in the system, connect tester as shown in figure 2-13 and conduct the TEE test. Block the supply to the remainder of the system at int A by installing a plug in the right side of the TEE.

CAUTION

MAKE SURE THE FLOW SELECTOR KNOB IS ON THE 100 GPM RANGE AND THE LOAD VALVE IS OPEN BEFORE STARTING THE EQUIPMENT.

Connect the tester inlet port to the tee and connect the return line to the reservoir.

NOTE

THE TESTER RETURN LINE MAY BE PLACED IN THE FILLER PORT OF THE RESERVOIR AND SECURED WITH TWINE OR SAFETY WIRE.

Check all the tester connections and system connections. Make sure which of the components will be tested when you turn on the system.

NOTE

EACH TIME YOU CHANGE THE POSITION OF THE TESTER IN THE SYSTEM, BE SURE YOU CHECK TO SEE WHICH COMPONENTS ARE BEING TESTED.

d. Pump Test. Start the system which is to be tested. Make sure that hydraulic fluid is flowing freely through the tester and returning to the system reservoir. Allow the system being tested to idle until the hydraulic oil heats to normal operating temperature.

WARNING

DO NOT EXCEED THE RELIEF VALVE SETTING REQUIRED BY THE TM OF THE EQUIPMENT BEING REPAIRED.

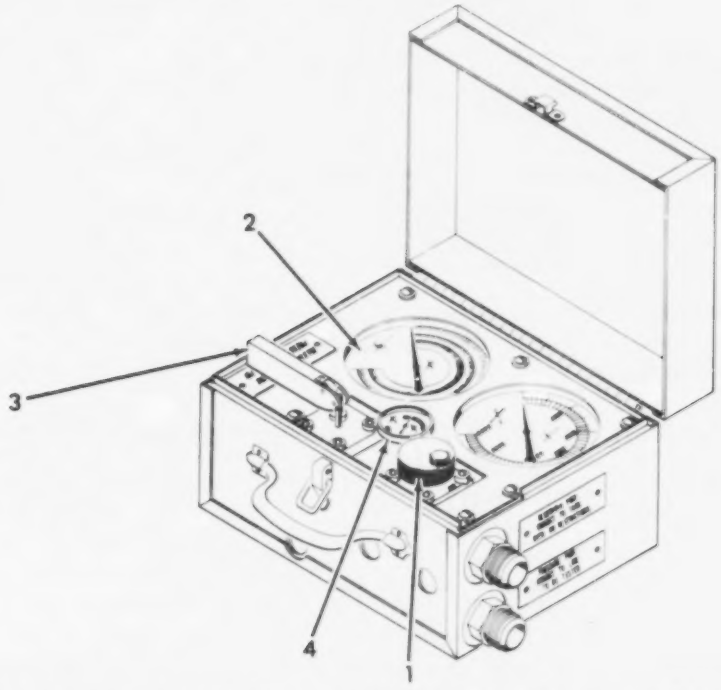
NOTE

IT MAY BE NECESSARY TO OPERATE AT ONE-HALF THROTTLE SETTING ON COLD DAYS.

IF THE PRESSURE FLUCTUATES, THE PUMP IS BAD OR THE PUMP SUCTION LINE IS BLOCKED OR LEAKING. CHECK THE PUMP SUCTION LINE FOR DENTS OR COLLAPSE. ALSO CHECK THE SUCTION LINE FILTER OR STRAINER AND REPLACE OR CLEAN IF DIRTY.

IN ALL TESTS, MAKE CERTAIN THAT THE DRIVE MOTOR IS OPERATING AT THE SAME RPM WHENEVER THE READINGS ARE TAKEN.

Accelerate the motor which drives the system to be tested to operating RPM. Hold that speed. Set the orifice (1) to the flow scale which permits the closest mid scale flow reading on the flow gage (2). Read the flow on the gage (2). Gradually lift the load lever (3) and move it outboard until the proper system operating pressure is obtained (1/2 to 3/4 of the relief valve setting). Read the temperature gage (4).



Compare the flow readings without pressure with the flow readings with pressure. Subtract the readings with pressure from those taken without pressure. If the flow reading with pressure is less than 3/4 of the the flow reading without pressure, the pump is bad. The technical manual covering the system which you are testing should have information in it to tell you if a pump with this flow rate, under a load, is operating adequately. Repair or replace the pump, as necessary, in accordance with the applicable technical data.

e. Systems Tee Test.

NOTE

A TEE TEST SHOULD ALWAYS BE DONE BEFORE PERFORMING THIS PROCEDURE. (SEE FIGURE 2-13).

Remove the plug from the TEE and reconnect the supply line which goes to the control valve.

NOTE

IT MAY BE NECESSARY TO FABRICATE SOME HOSE ASSEMBLIES TO ACCOMPLISH THIS.

Shift the first control valve to extend the cylinder or operate a hydraulic motor. Depress the load valve on the tester and extend the cylinder until it slowly bottoms. If the valve is used to operate a hydraulic motor, apply maximum rated load to the motor and move the load by depressing the load valve lever on the tester.

NOTE

KEEP THE ENGINE RPM (OF THE EQUIPMENT BEING TESTED) CONSTANT DURING ALL TESTS.

The output of the pump must overcome the tester load valve or slip past a worn, leaking component in the system. Read the flow on the flow meter and compare that reading to the reading for the pump under pressure (paragraph 2-13d). If there is a decrease in flow across the tester (lower than the flow in paragraph 2-13d) there is leakage, slippage, or a malfunctioning component in the system. Repeat this procedure for each actuation position of each control valve. The fault will be in the circuit with low flow. The following paragraphs describe how to isolate that malfunction.

NOTE

WHEN TESTING A HYDRAULIC CIRCUIT THAT INCLUDES A HYDRAULIC MOTOR, KEEP THE SYSTEM PRESSURE A LITTLE BELOW THE PRESSURE REQUIRED TO MOVE THE LOAD.

(1) Relief Valve. Plug the control valves' output ports and shift the valve lever to an actuating position. Depress the load lever on the tester until the relief valve setting pressure is achieved.

WARNING

DO NOT EXCEED THE MAXIMUM RATED PRESSURE OF THE SYSTEM.

Note the pressure at which the relief valve opens. Compare that pressure with the system specifications. Correct the relief setting or repair or replace the relief valve as necessary. If the relief valve is operating correctly, continue to isolate and check system components. The following paragraphs describe how to do that.

(2) Downstream Components.

NOTE

THE PROCEDURES IN PARAGRAPHS 2-13c, d, AND e(1) MUST BE COMPLETE BEFORE BEGINNING THE PROCEDURES IN THIS PARAGRAPH.

Remove the plugs from the control valve outlet ports and connect the lines. Position the cylinder rod at 1/2 (approx.) extension, disconnect one line from a cylinder, and plug it and the cylinder port. Shift the control valve and apply pressure to the port that is still connected to the cylinder. Depress the load valve lever on the tester until the pressure reaches 3/4 of the relief valve setting. If the flow is lower than the flow measured when testing the pump under load in paragraph 2-13d, the control valve or the relief valve (in the control valve body) is malfunc-

tioning. If the cylinder rod extends, the cylinder piston seal is bad. If neither of these occur, either the cylinder or the cylinder linkage is binding.

(a) Single Acting Cylinders. Shift the cylinder control valve to the cylinder extend position. Fully extend the cylinder by actuating the load valve on the tester. When the cylinder is fully extended, apply a pressure of 3/4 of the relief valve setting by depressing the load lever on the tester. If flow is less than that measured for the pump under load in 2-13d and there is no external cylinder leakage, the control valve or relief valve is bad and must be replaced or repaired.

(b) Motor. This procedure is the same as the procedure in paragraph 2-13e(2)(a). If the flow does not decrease, the motor is bad.

(c) Flow Control Valve. Measure the flow downstream of the flow control valve at 1/2 and 3/4 Engine RPM. If it changes by more than 20% (unless otherwise specified in the TM of the faulty equipment) the valve is malfunctioning.

(d) Counter Balance or Lock Valves. These valves are included to keep a cylinder or motor from moving accidentally. These valves block the output ports and prevent flow out of the cylinder (or motor) ports until pressure is applied to the other port.

WARNING

DO NOT OPERATE THE SYSTEM WHEN USING THE TESTER LOAD VALVE FOR MORE THAN 10 - 20 SECONDS AT A TIME AS THIS WILL CAUSE THE SYSTEM OIL AND THE TESTER TO OVERHEAT. DO NOT OPERATE THE SYSTEM AT RELIEF SETTING FOR MORE THAN 10 - 20 SECONDS AS THIS WILL CAUSE THE RELIEF VALVE TO OVERHEAT. WATCH THE TEMPERATURE GAGE. IF THE TEMPERATURE REACHES 100°F OVER AMBIENT, ALLOW THE SYSTEM TO COOL BEFORE CONTINUING.

If a cylinder or motor will not move when pressure is applied and the hydraulic circuit has checked out up to the lock or counter balance valves attach the multigage to one port of the cylinder (insert a tee at the cylinder port so that the normal line can be hooked up with the gage in the circuit) and apply pressure to the other port. If the pressure at the gage port rises to the system relief valve setting, the valve has malfunctioned. If the pressure does not rise, the cylinder is jammed.

NOTE

THE PISTON MAY BE BINDING, THE CYLINDER ROD IS BENT, OR THE MECHANICAL LINKAGE HOOKED TO THE CYLINDER IS BENT OR BINDING.

IT MAY BE NECESSARY TO REMOVE SOME TUBE ASSEMBLIES AND TEMPORARILY REPLACE THEM WITH HOSE ASSEMBLIES TO PERFORM THIS TEST.

For a motor, if the pressure at the outlet port rises to the relief valve setting, the valve has malfunctioned. If the pressure does not rise to the relief valve setting, the motor is bad.

NOTE

BEFORE A LINE IS DISCONNECTED, THE ENGINE MUST BE TURNED OFF. COLLECT ALL OIL IN A CLEAN DRY CONTAINER. RETURN THIS OIL TO THE RESERVOIR USING THE TRANSFER PUMP.

4. Transfer Pump. This unit has been designed primarily as a transfer pump intended for replenishing hydraulic ems with clean, filtered oil. It can also be used as a clean-up pump by recirculating hydraulic oil within a reser- or container.

NOTE

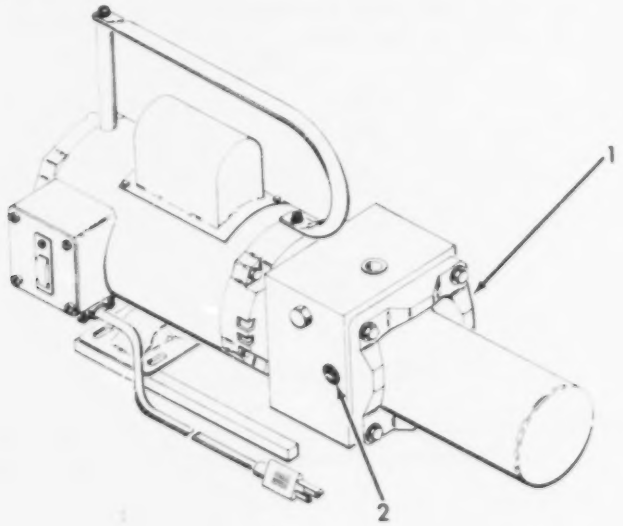
IF A LARGE SUCTION LINE IS TO BE DISCONNECTED THE OIL SHOULD BE PUMPED OUT OF THE RESERVOIR.

a. Preparation for Use. Locate the sump drain of the system to be cleaned or drained. Drain condensation, rt, contaminants, etc., which have settled in the drain from the system. Place the unit in position to start work. heck to be sure that the positioning allows for attachment of hose. Before connecting the transfer pump, check to e that the recommended hose size and length and recommended maximum operational characteristics are being mplied with. Make sure that hoses and fittings are clean prior to connecting them. Connect the unit, prepare th ansfer pump (if required), and start the unit. See paragraph 2-14b for instructions for using the transfer pump.

NOTE

TAKE ALL PRACTICAL MEASURES TO PROTECT THE SYSTEM FROM OUTSIDE DIRT.

b. Using the Transfer Pump. Remove the plastic cap from the inlet port (1) and connect the inlet hose. Place the opposite end of the inlet hose in the reservoir from which hydraulic oil is to be pumped or removed. Remove the plastic cap from the outlet port (2) and connect the outlet hose.



NOTE

THE FLUSHING FILTER INCLUDED IN THE HSTRU MAY BE INSTALLED IN THE LINE AFTER THE PUMP, IF DESIRED. IF TRANSFER PUMP BYPASSES ITS OWN FILTER WHEN PLUMBED THIS WAY - FLUSHING CAN CONTINUE.

Place the opposite end of the outlet hose into the receiving tank or reservoir.

CAUTION

BE SURE THAT BOTH HOSES ARE PROPERLY POSITIONED AND SECURED. BE SURE THAT THE DIRECTION OF HYDRAULIC OIL FLOW WILL BE AS YOU WANT IT.

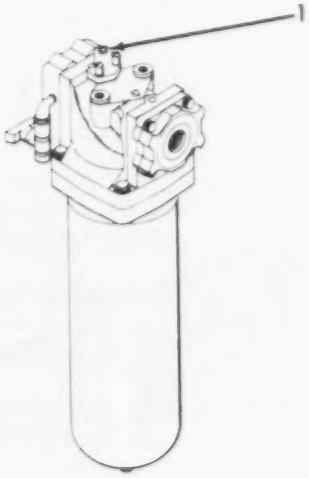
Move the switch to the "on" position.

2-15. Flushing Filter. The flushing filter is provided to remove systems contaminants. The flushing filter must be used whenever a system has been opened for test or repair (replacement of a hydraulic line, troubleshooting.,etc.). The flushing filter should also be used when there is evidence that the system is contaminated (hydraulic systems is erratic or hydraulic oil is visibly dirty). The usual procedure is to connect the filter to the vehicle return line and to connect a hose line assy from the filter outlet to the reservoir filler port, (a hose assembly must be fabricated for this purpose).

Operate the system at 1/2 to 3/4 throttle and flush each circuit by actuating each control valve for 20 minutes. If the filter elements get clogged the oil will be bypassed around the elements and the indicator (1) will be in the red area.

NOTE

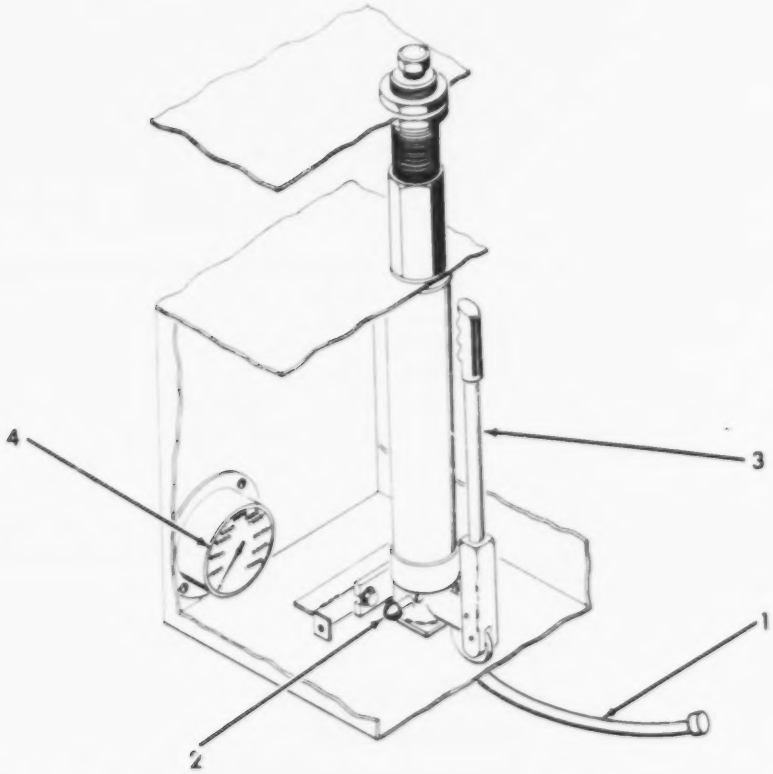
IF A LINE IS RUN TO THE RESERVOIR FILLER PORT, IT SHOULD BE SECURED TO PREVENT OIL FROM SPRAYING ALL OVER THE AREA.



16. **Proof Pressure Tester.** To operate the proof pressure tester (HAND PUMP), first perform your (B) PMCS, m 11. A pressure gauge is plumbed into the system, immediately after the pump. It allows you to know the essure being put out by the pump. To operate the pump, connect the output hose (1) to the component to be sted. Close the load relief valve (2). Pump the handle (3) until the desired pressure can be read on the gauge (4). bleed pressure, open the load relief valve.

NOTE

PROOF PRESSURE CHECKS OF COMPONENTS ARE USUALLY RUN AT 1-1/4 TIMES THE SYSTEM RELIEF VALVE SETTING. PROOF PRESSURE CHECKS OF LINES ARE RUN AT TWICE THE SYSTEM RELIEF VALVE SETTING.



2-17. **Tachometer.**

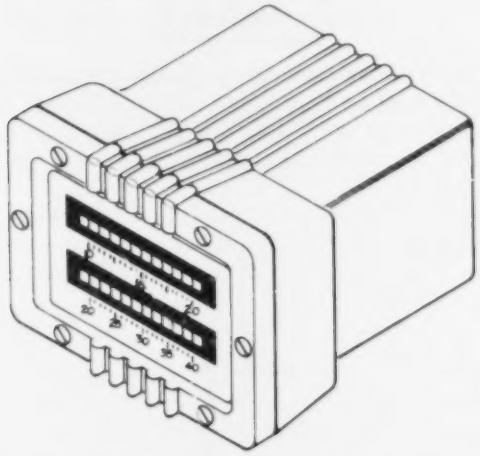
NOTE

USE INSTALLED TACHOMETERS WHEN AVAILABLE.

The HSTRU tachometer may be used in conjunction with the tester for testing and troubleshooting equipment, where a desired output pressure is specified as a function of engine/pump speed.

NOTE

RPM MAY BE MEASURED BY HOLDING THE TACHOMETER AGAINST THE INLET LINE AT THE TESTER.



This tachometer measures vibration. Its range is from 1000 RPM to 4000 RPM. Care must be used in selecting a point on the vehicle that vibrates in synchronism with engine RPM.

NOTE

IT IS NOT NECESSARY TO RUN HYDRAULIC SYSTEM TESTING AT A SPECIFIC RPM AS LONG AS THE ENGINE SPEED IS CONSTANT DURING ALL TESTS.

Vary the engine speed after you select the point where you are going to place the tach. If the tach indicates a corresponding increase and decrease in RPM, the point selected is adequate. To use the tachometer merely place it in metal to metal contact. Place on motor, pump, engine or inlet line at the tester.

2-18. Impact Wrench.

WARNING

ONLY IMPACT DUTY TYPE SOCKETS CAN BE USED WITH IMPACT WRENCH. OTHER TYPES OF SOCKETS, IF USED, MIGHT SHATTER AND FLY, ENDANGERING THE SAFETY OF THE OPERATOR AND OTHERS IN THE IMMEDIATE VICINITY. MAKE CERTAIN THAT THE SOCKETS ARE OF THE IMPACT DUTY TYPE - FOR USE WITH IMPACT WRENCHES.

DO NOT CHANGE DIRECTION OF ROTATION WHILE SWITCH IS ON. WAIT UNTIL MOTOR HAS COMPLETELY STOPPED.

WARNING

VERIFY THAT DIRECTION OF ROTATION IS CORRECT FOR OPERATION TO BE PERFORMED BEFORE BEGINNING THE OPERATION.

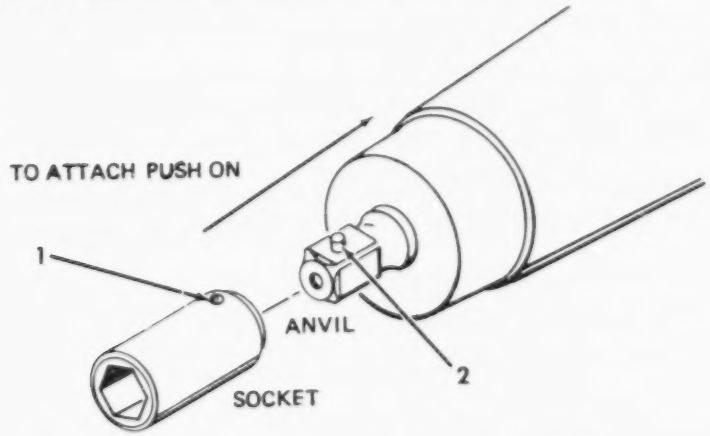
POSITION THE WRENCH SO THAT THE SOCKET FITS SQUARELY ON THE NUT OR BOLT.

IT IS CHARACTERISTIC OF THE TYPE MOTOR USED IN PORTABLE ELECTRIC TOOLS TO FAINTLY SPARK AT THE PLACES WHERE THE BRUSHES CONTACT THE ARMATURE COMMUTATOR. THIS SPARKING IS QUITE NORMAL AND WILL NOT HARM THE TOOL. BECAUSE OF THIS SPARKING, HOWEVER, PORTABLE ELECTRIC TOOLS SHOULD NEVER BE STARTED OR RUN WHERE THERE IS ANY POSSIBLE CHANCE THAT A FIRE OR EXPLOSION MIGHT OCCUR DUE TO THE PRESENCE OF MANUFACTURED OR NATURAL GAS, GASOLINE, NAPTHA, SOME TYPES OF PAINT THINNERS, FUMES FROM THESE THINNERS AND PAINTS THINNED BY THEM, ETC.

CAUTION

DUE TO VIBRATION CREATED BY AN IMPACT WRENCH, CHECK ALL OUTER SCREWS OCCASIONALLY AND TIGHTEN IF LOOSE. USE CARE TO AVOID OVERTIGHTENING BOLTS OR YOU MIGHT TWIST THEM OFF OR STRIP THE THREADS.

a. Installing Sockets, Chucks, or Adapters. The impact wrench is designed to tighten or loosen bolts and nuts up to 1/2" in diameter. To attach sockets, chucks, and adapters, line up the hole (1) with the detent pin (2).



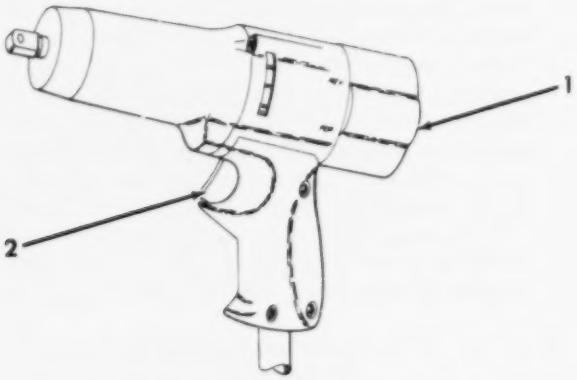
Depress the pin (2) and push the socket, chuck, or adapter firmly on to the anvil.

b. Direction of Rotation.

WARNING

ALWAYS STOP THE WRENCH BEFORE CHANGING THE DIRECTION OF ROTATION.

The direction of rotation of the anvil is controlled by turning the end cap (1) at the rear of the wrench. For clockwise rotation, twist the end cap (1) counterclockwise until it locks in place. For counterclockwise rotation, twist the end cap (1) clockwise until it locks in place.



c. Installing Fasteners. To install fasteners, set the end cap for the desired direction of rotation. Start the nut on the stud or start the fasteners in the hole.

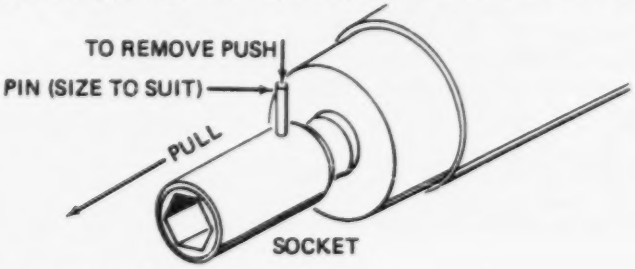
WARNING

PLACE THE WRENCH SO THAT THE SOCKET FITS SQUARELY ON THE NUT OR BOLT.

Press the trigger (2) to drive the nut or fastener until it seats on the material being fastened. Then, put some forward pressure on the wrench. This will cause the hammer, in the wrench to snug up the nut or fastener.

d. Removing Fasteners. Set end cap for desired direction of rotation. Place socket over nut or fastener head. Exert forward pressure on wrench as you depress switch trigger. As soon as the nut or fastener becomes loosened, relax forward pressure on wrench to let it spin nut or fastener free.

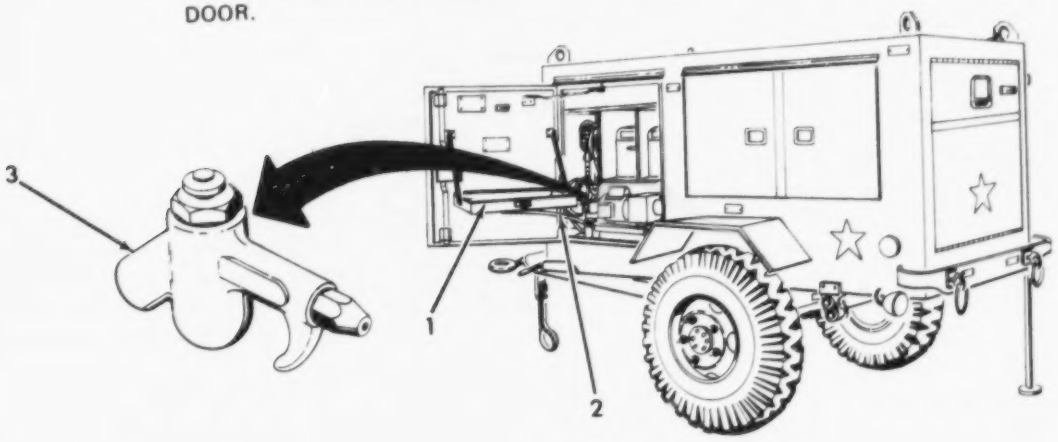
e. Removing Sockets, Chucks, and Adapters. To remove a socket, chuck, or adapter, insert a pin in the hole and depress the detent pin while pulling the socket, chuck, or adapter off of the impact wrench.



-19. **Solvent Wash Unit.** Before using the solvent wash unit, perform (B) PMCS (as much as applies to the solvent ash unit). Apply electrical power to the HSTRU as described in (B) PMCS, item 4 and in paragraph 2-6 steps a-d. lug the wash pump into electrical outlet. Fold the wash tray (1) down and make certain that it is secure. Check the olvent return line (2) and make sure it is securely installed and free of crimps. Place the component or item to be vashed in the wash tray (1) and use the nozzle (3) to wash it with solvent. Stow the wash tray. Make sure that there re no air bubbles in the line by shaking it gently until any existing drain bubbles are worked out. Make sure that no oses or lines are crimped or pinched when you stow the tray.

NOTE

USE CARE WHEN CLOSING THE WASH TRAY ACCESS DOOR. DO NOT PINCH DRAIN HOSE WHEN CLOSING DOOR.



2-20. O-ring Fabrication Kit. The o-ring fabrication kit contains all of the materials necessary to make o-rings. This kit should be used for on-the-spot production of stationary o-rings for use as pump seals, flanged pipe seals, vacuum seals, or irregular shaped seals.

CAUTION

THE O-RING FABRICATION KIT SHOULD NOT BE USED TO MAKE DYNAMIC (MOVING) O-RING SEALS.

Use the following procedure to make o-rings:

WARNING

THE RAZOR BLADE IS SHARP. BE CAREFUL NOT TO CUT YOURSELF.

a. Make sure the protective oil film has been removed from the single edge razor blade in the kit. If it has not, wash the razor blade with solvent.

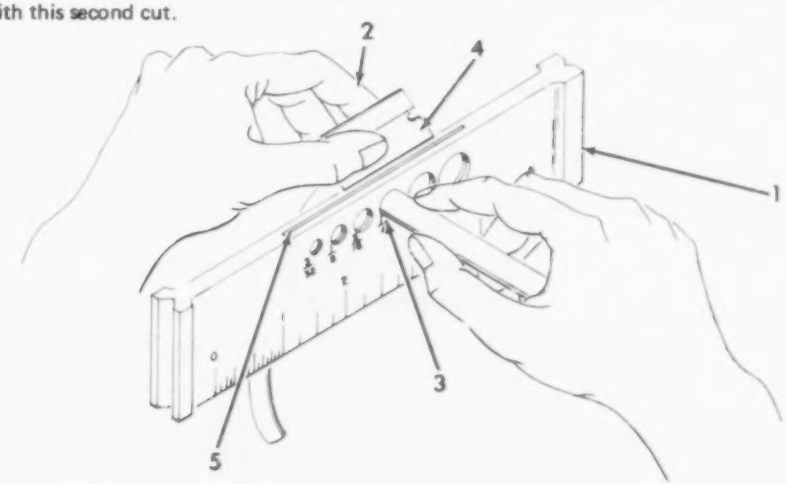
b. Determine the proper cord length. To do this, place the correct diameter cord in the groove or around the shaft where the seal is required and mark it. Add 1/4" beyond this mark and cut the cord.

NOTE

IF THE OLD O-RING IS AVAILABLE, CUT IT AND LAY IT OUT FLAT AND STRAIGHT. USE THIS O-RING TO MEASURE AGAINST. ADD 1/4" TO ALLOW FOR TRIMMING.

THIS DOES NOT NEED TO BE A SQUARE CUT.

c. Square the cord ends. Get the o-ring fabrication fixture (1) and hold your finger over one side of the hole (2) that is the same diameter as the cord you are cutting. Stick the cord in the same hole from the other side (3). Push it in until your finger stops it. Hold the cord firmly at a right angle to the fixture (1). Insert the razor blade (4) in the slot (5) on top of the fixture (1) and slice the cord. This will give you a square cut. Repeat the procedure using the other end of the cord. Cut the cord to proper length with this second cut.



d. Apply adhesive to one end.

WARNING

AVOID CONTACT BETWEEN SKIN AND ADHESIVE.

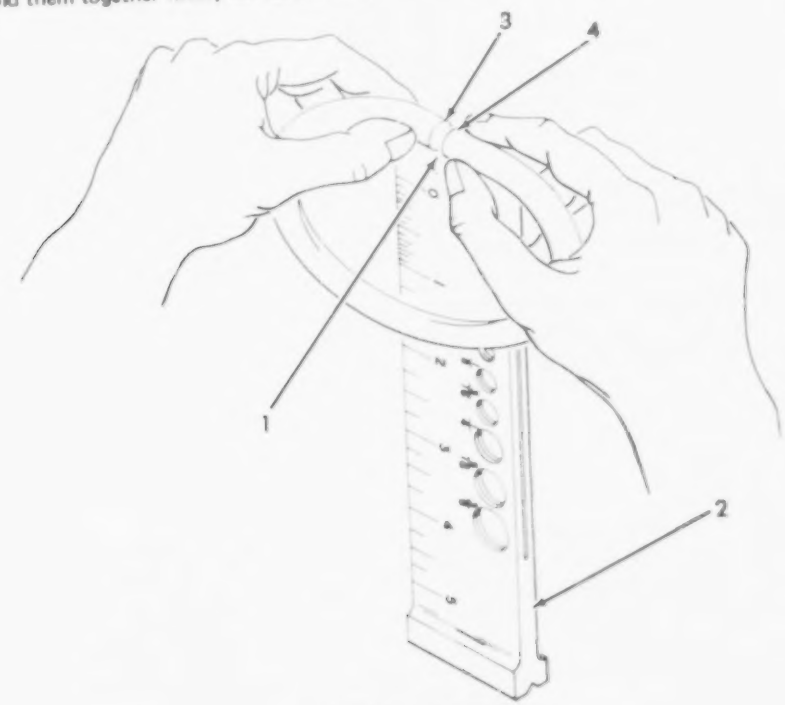
CAUTION

USE ADHESIVE SPARINGLY.

NOTE

GO IMMEDIATELY TO THE NEXT STEP.

e. To assure proper alignment, use the "V" groove (1) on the end of the fabrication fixture (2). Place the end of the cord (3) which has the adhesive on it in the groove (1) as shown. Then place the end of the cord (4) which does not have adhesive on it in the groove. Line up the two ends of the cord and join them together in the groove. Hold them together firmly for 30 seconds.



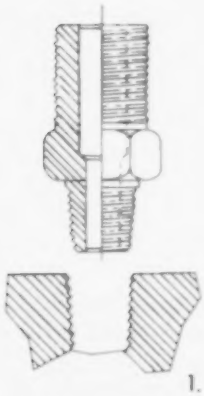
CAUTION

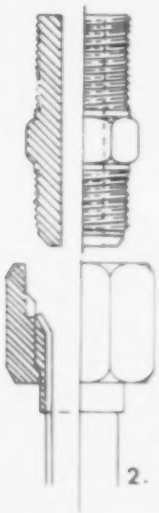
DO NOT SUBMERGE THE JOINT IN THE CLEAN UP SOLVENT.

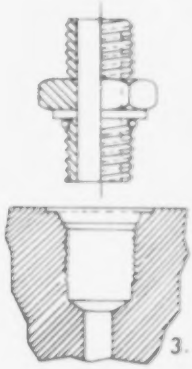
Make sure that the o-ring hangs free and is not crimped or twisted in any way. If necessary, remove any excessive adhesive from around the joint. To do this, apply clean up solvent (included in the kit) to a clean, dry, lint free rag and wipe the joint.

f. Brush a thin coat of water proofing solution (included in the kit) around the joint. Allow it to dry for 5 to 10 minutes. The fabricated o-ring is now ready for use.

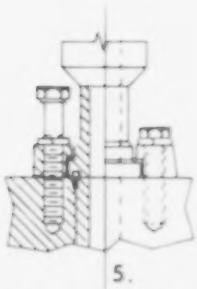
2-21. Troubleshooting Adapter Kit. The adapter kit is provided to connect the multigage, flushing filter, and hydraulic system tester to hydraulic systems. The adapter kit also provides the fittings needed to connect components to the hand pump for proof pressure testing. Since all connections in hydraulic systems are not the same, it is usually necessary to adapt for both size and type of connection. The types of connections frequently found in hydraulic systems are: national pipe thread (NPT) (1), 37 degree flare (2), o-ring boss (3), flareless (4), and the 4-bolt split flange face and head (5). Sometimes it may also be necessary to use fittings from the tube fitting kit no. 2 (for fittings with MS numbers). Because National Pipe Thread (NPT) fittings are the only fittings for which adapters to other types of connections are readily available, all adaptions of connection types and sizes are made with NPT fittings. What this means is that connections are first adapted to NPT, then adapted to the proper size and finally adapted to the test instrument or proof pressure tester.


1.


2.


3.

4.


5.

CAUTION

BE SURE THAT YOU MATE A FITTING ONLY WITH THE FITTING IT WAS DESIGNED TO MATE WITH. NEVER DEPEND ON TRIAL AND ERROR. JUST BECAUSE TWO FITTINGS WILL SCREW TOGETHER IS NO GUARANTEE THAT IT WILL NOT LEAK.

IT IS POSSIBLE TO SCREW A MALE NPT THREAD INTO A FEMALE STRAIGHT THREAD, BUT THE FITTING WILL LEAK. LEARN TO RECOGNIZE THE VERY SLIGHT TAPER WHICH A NPT HAS.

DO NOT ATTEMPT TO USE THE PARTS OF THE 37° FLARE FITTING AND THE FLARELESS FITTING WITH EACH OTHER. THE FITTING WILL LEAK.

WHEN CONNECTING NATIONAL PIPE THREADS (NPT) CARE MUST BE EXERCISED. IF OVERTIGHTENED, THE FEMALE PIPE THREAD WILL SPLIT. IF A CONNECTION LEAKS, DISCONNECT AND APPLY THREAD SEALANT. RECONNECT THE THREADS AND SNUG UP WITH AN OPEN END WRENCH.

DO NOT APPLY SEALANT TO THE FIRST THREAD. IF SEALANT ENTERS THE HYDRAULIC SYSTEM, IT MAY CAUSE RELIEF VALVES, FLOW CONTROL VALVES, OR PRESSURE REDUCING VALVES TO STICK.

WHEN REPLACING O-RINGS USE THE TOOLS PROVIDED WITH THE O-RING KIT. BE CAREFUL WHEN SLIPPING THE O-RING OVER SHARP THREADS. DO NOT NICK THE O-RING.

DO NOT OVERTIGHTEN A FLARELESS CONNECTION. SNUG THE CONNECTION UP AND TURN AN ADDITIONAL 1/8-1/4 TURN. IF OVERTIGHTENED, THE ENTIRE TUBE ASSEMBLY MUST BE REPLACED.

NOTE

THERE IS USUALLY AN ADAPTER IN THREADED PORTS. THIS ADAPTER GOES FROM ONE TYPE OF CONNECTION TO ANOTHER. USUALLY THIS ADAPTER IS REMOVED WHEN ATTACHING TEST EQUIPMENT TO THE PORT. DO NOT LOSE THIS ADAPTER, AS IT MUST BE REPLACED WHEN THE TEST EQUIPMENT IS DISCONNECTED FROM THE HYDRAULIC SYSTEM.

WHEN AN O-RING BOSS CONNECTION LEAKS, THE O-RING IS BAD AND SHOULD BE REPLACED.

NOTE

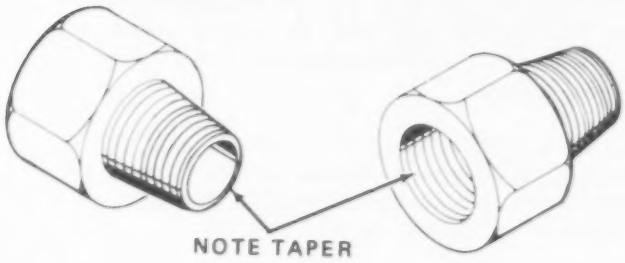
WHEN THE FLARELESS CONNECTION LEAKS AFTER TIGHTENING, THE CONNECTION IS BAD AND THE TUBE ASSEMBLY MUST BE REPLACED.

WHEN A 4-BOLT SPLIT FLANGE LEAKS THE O-RING IS BAD OR THE FACE AREA IS DENTED OR SCRATCHED OR ONE OR MORE OF THE BOLTS IS TOO LONG.

a. National Pipe Thread (NPT). This thread is commonly found in hydraulic systems. It differs from other fittings in that it is tapered. In order to obtain a proper seal with this thread you must use a sealant. The sealant should be applied on the male fitting.

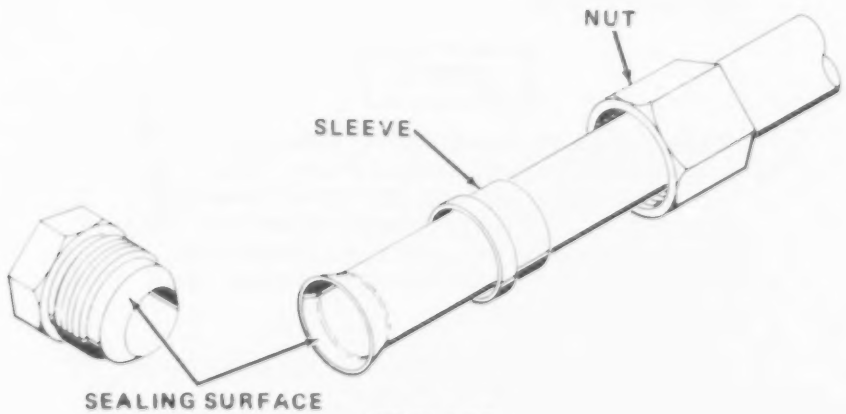
CAUTION

DO NOT APPLY SEALANT TO THE LEADING EDGE OR THE FIRST THREAD, OR SEALANT MAY GET INTO THE HYDRAULIC SYSTEM AND CONTAMINATE IT.



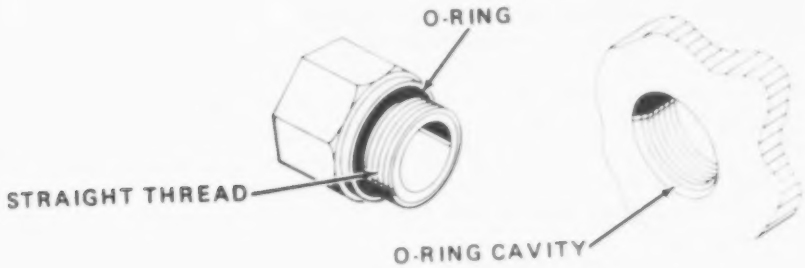
NATIONAL PIPE THREAD

b. 37° Flare. The 37° flare termination has a male straight thread that mates with a female straight thread. The sealing surface for this termination is the angled nose at the end of the male fitting. This nose mates with a similar surface in the female 37° flare fitting. These sealing surfaces must be free of nicks and scratches in order to seal properly.



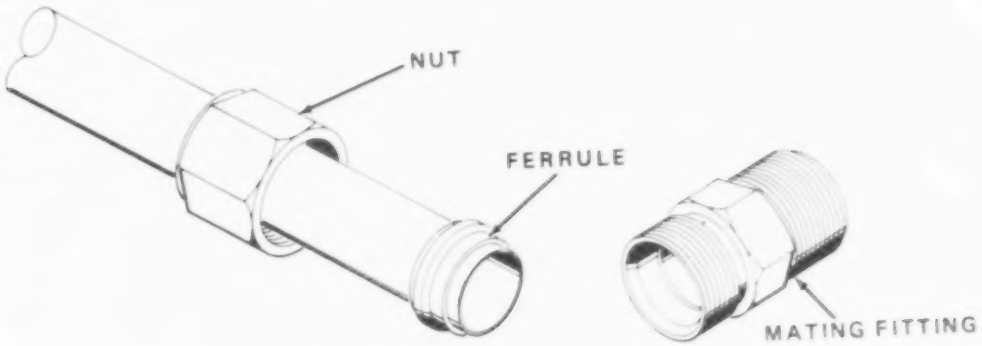
37° FLARE

c. *O-Ring Boss.* The o-ring boss termination also has a straight thread. The seal for this termination is an o-ring that fits at the top of the thread. This o-ring is squeezed into the extra space at the top of the female thread and seals the connection. The o-ring must be free of nicks and cuts to seal properly.



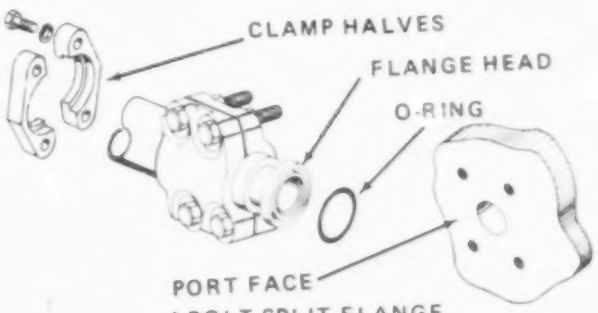
O-RING BOSS

d. *Flareless.* This fitting also uses a straight thread. The female fitting contains a ferrule that mates with a cavity in the male fitting. If this fitting is overtorqued the ferrule will be deformed and the fitting will leak.



FLARELESS

e. *4-Bolt Split Flange.* The 4-bolt split flange has a flange head that is clamped to a smooth face. The flange head has an o-ring that is squeezed between the head and the face. The face and the end of the flange head must be free of nicks and scratches to seal properly. The o-ring must also be free of nicks and cuts or the connection will leak.



4-BOLT SPLIT FLANGE

f. Adaption of the Hydraulic System Tester. The tester is usually connected by a TEE to the pump outlet (ref. figure 2-13). Examples of how to connect the tee into the system are provided in tables 2-4 through 2-9.

NOTE

IT MAY BE NECESSARY TO FABRICATE A HOSE ASSEMBLY IN ORDER TO INSERT THE TEE.

Determine the type of connection and select an adapter that will adapt this connection to pipe thread. Select the proper size pipe nipple and tee and connect these to the adapter. Now select an adapter that will adapt from the pipe tee to the line that was disconnected from the pump. Connect the line and adapter to the tee. This completes the installation of the tee. Finally, select an adapter to connect the tee to the hydraulic system tester. Examples of how to connect the hydraulic system tester to the tee are shown in table 2-10.

NOTE

IT WILL BE NECESSARY TO FABRICATE TWO HOSE ASSEMBLIES, ONE TO CONNECT THE TESTER TO THE TEE AND ONE TO CONNECT THE TESTER RETURN LINE TO THE RESERVOIR.

USUALLY JUMP SIZE PIPE ADAPTERS WILL BE REQUIRED TO CONNECT THE TEE TO THE HOSE ASSEMBLY THAT GOES TO THE TESTER INLET.

g. Adaption of the Multigage. Normally, a tee must first be inserted in the line where pressure is to be measured. Use the procedure in para. 2-21a.

NOTE

SOMETIMES A PRESSURE MEASUREMENT TAP IS AVAILABLE AT PUMPS AND CONTROL VALVES. IF SUCH A TAP IS PRESENT, SELECT THE PIPE ADAPTERS OR BUSHINGS REQUIRED TO MATCH THE MULTIGAGE CONNECTION (1/8 NPT MALE).

Examples of how to connect the multigage to the tee are shown in table 2-11.

h. Adaption of the Proof Pressure Tester. Examples of how to connect to the proof pressure tester are shown in tables 2-12 through 2-14 and figures 2-22 through 2-26.

i. Adaption of the Flushing Filter to the Return Line. Examples of how to adapt the flushing filter inlet to the return lines are shown in table 2-15 and figure 2-27. It will be necessary to fabricate a 1" hose assembly to connect the flushing filter outlet to the reservoir filler port. Connect the hose to the filter outlet using union No. MS 51501B16 from tube fitting kit No. 2 and a 1" o-ring from the o-ring packing kit in tool kit no. 9.

NOTE

SECURE THE HOSE ASSEMBLY TO THE RESERVOIR FILLER PORT TO PREVENT OIL FROM SPRAYING THE AREA.

Table 2-4. Connecting a Pipe Thread Port to a TEE.

A Pipe Thread Port Nom Size	B Pipe Nipple	C TEE
1/4	0706	7048
3/8	6457	7118
1/2	6458	7119
3/4	6459	7120
1	6460	7121
1-1/4	6461	6118
1-1/2	6462	7122

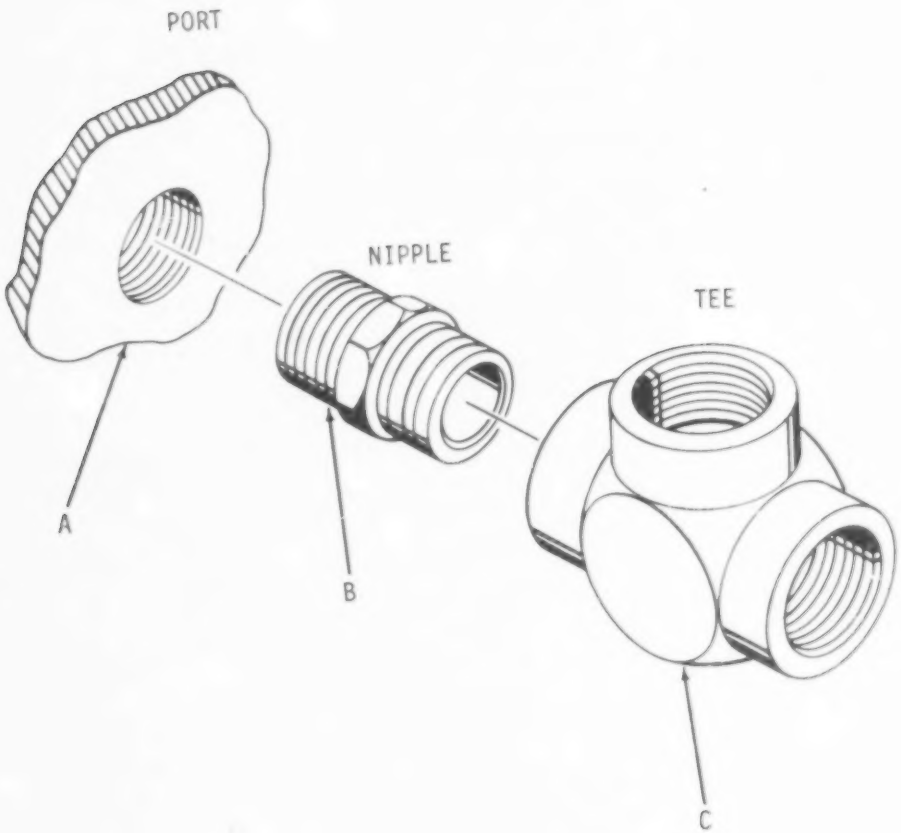


Figure 2-14. Connecting a Pipe Thread Port to a TEE.

Table 2-5. Connecting an O-Ring Boss Port to a TEE.

A O-Ring Boss Port Nom Size	B Adapter O-Ring Boss to Pipe Thread	C Pipe Nipple	D Pipe Bushing	E TEE
1/4	6525	0706		7048
3/8	1403	0706		7048
1/2	7254	6458		7119
5/8	6484	6458		7119
3/4	0765	6459		7120
7/8	7127	6459		7120
1	6485	6460		7121
1-1/4	6486	6460	6480	6118
1-1/2	7128	6460	6480	6118

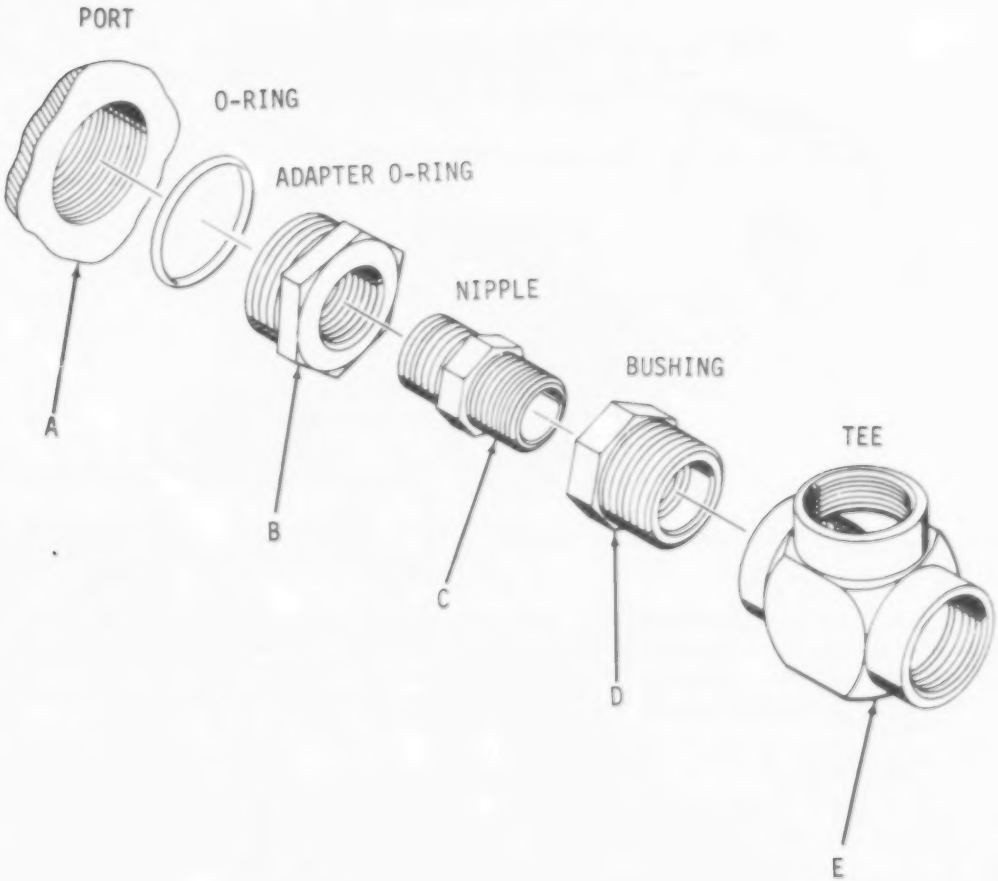


Figure 2-15. Connecting an O-ring Boss Port to a TEE.

Table 2-6. Connecting a 37 Degree Flare Line to the TEE.

A 37 Degree Flare Female Line Nom. Size	*B Adapter Pipe Thread/ 37 Degree Flare	C TEE
1/4	MS 51500B4-4	7048
5/16	MS 51500B5-4	7048
3/8	MS 51500B6	7048
1/2	MS 51500B8-8	7119
3/4	MS 51500B12	7120
7/8	MS 51500B14	7120
1	MS 51500B16	7121
1-1/4	MS 51500B20	6118
1-1/2	7140	7121

* These adapters are provided in the tube fitting kit.

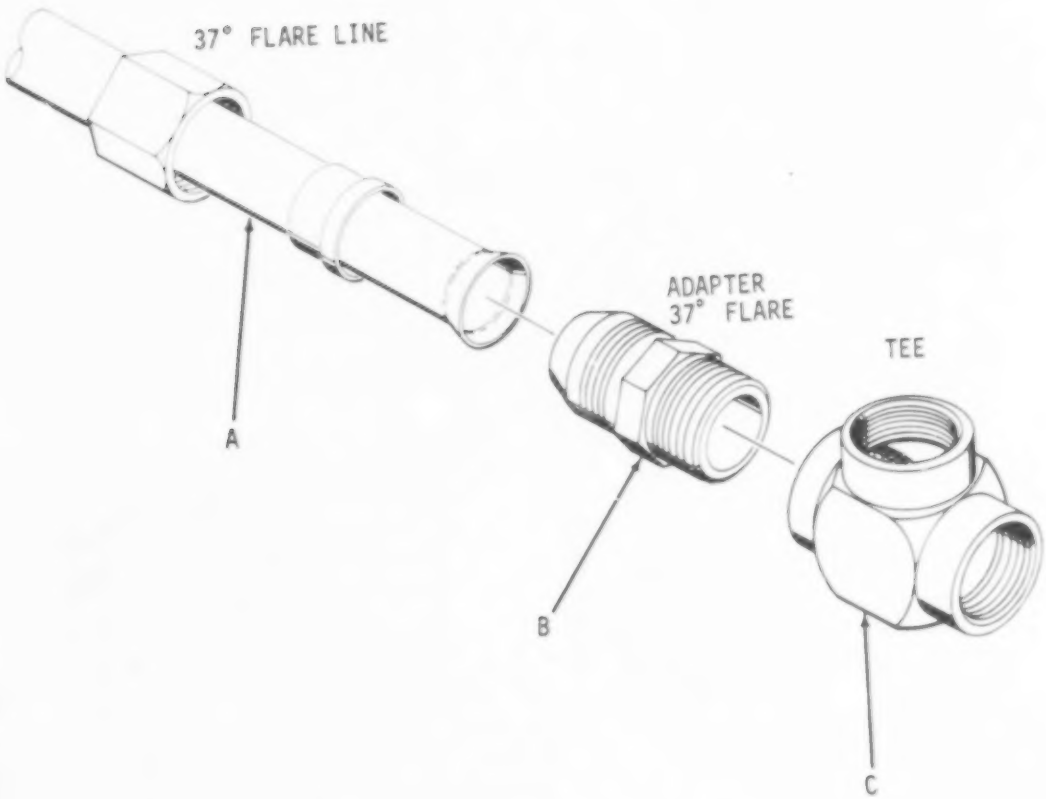


Figure 2-18. Connecting a 37 Degree Flare Line to the TEE.

Table 2-7. Connecting a Flareless Line to the TEE.

A Flareless Line Nom. Size	B Adapter Flareless to Pipe Thread	C Pipe Bushing or Adapter	D TEE
1/4	7129		7048
5/16	7130		7048
3/8	7131		7048
1/2	7133		7119
5/8	7134		7119
3/4	7135		7120
1	7136		7121
1-1/4	7137		6118
1-1/2	7138	7125	6118

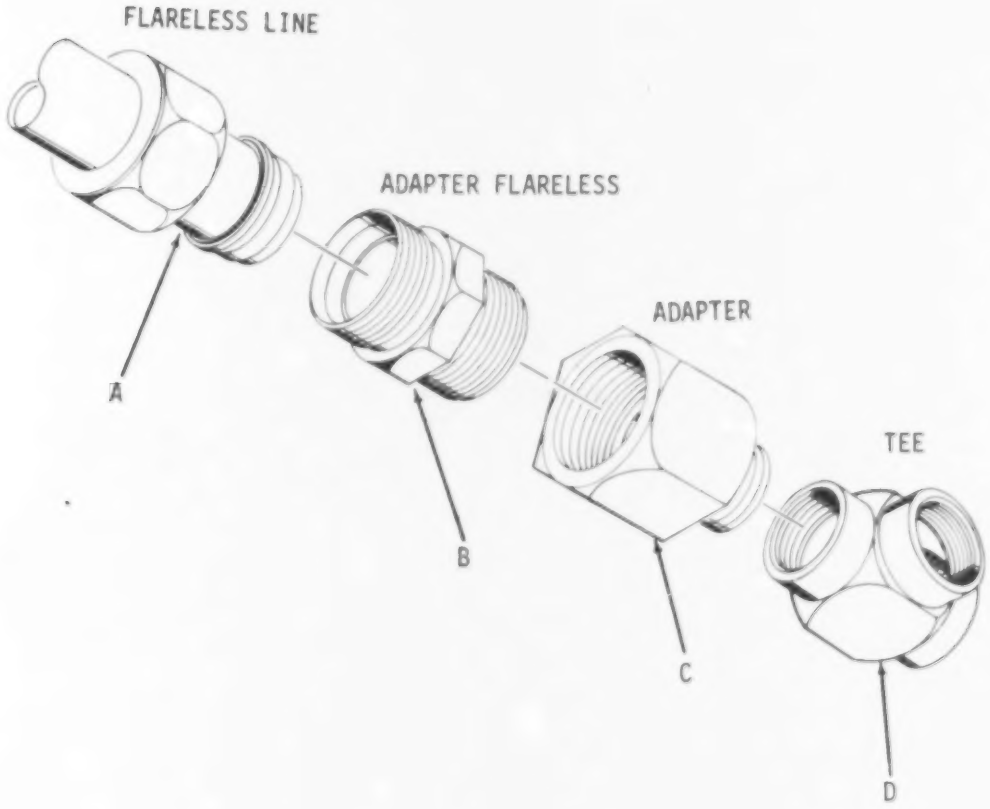


Figure 2-17. Connecting a Flareless Line to the TEE.

Table 2-8. Connecting a 4-Bolt Split Flange Port to a TEE.

A Flange Port Nom. Size	B Adapter Flange Head to 37° Flare	C Clamp* Halves Nom. Size	D Reducer 37° to 37°	E Reducer 37° to 37°	F Hose Assy. 37° to 37° Nom. Size	G Adapter 37° to Pipe Nom. Size	H TEE
1/2	2206	1/2			1/2 to 1/2	MS 51500B8-8	7119
3/4	2321	3/4			3/4 to 3/4	MS 51500B 12	7120
1	6126	1			1 to 1	MS 51500B 16	7121
1-1/4	2322	1-1/4	6335	1025	1 to 1	MS 51500B 16	7121
1-1/2	2325	1-1/2			1 to 1	MS 51500B 16	7121

* Obtain clamp halves from box no. 13.

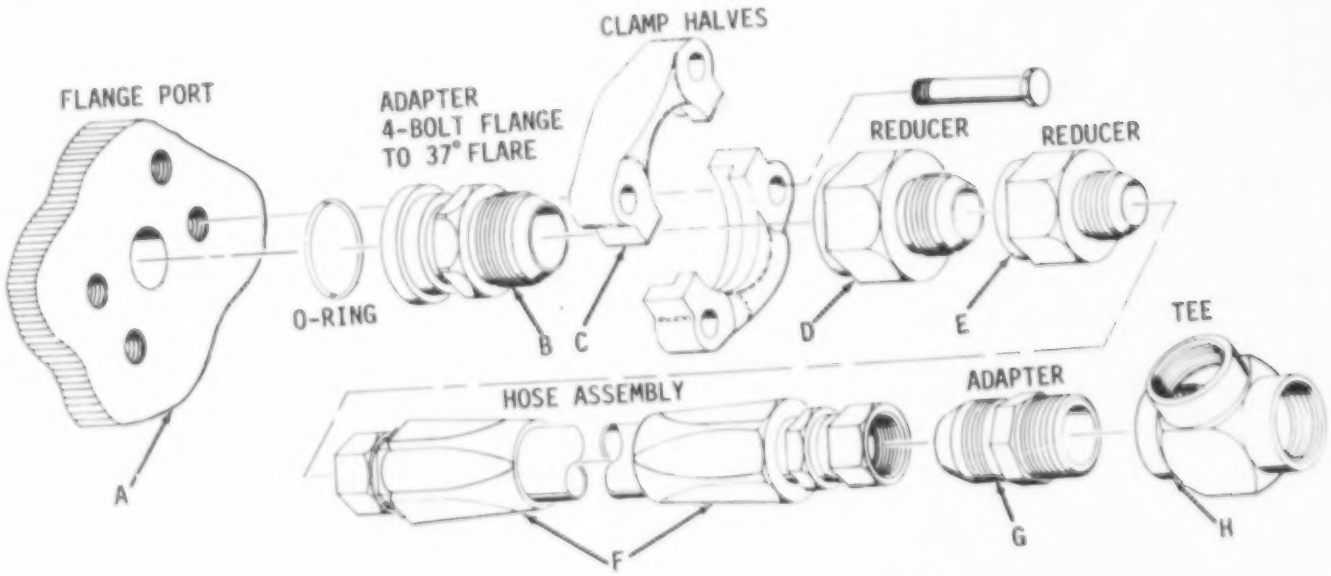


Figure 2-18. Connecting a 4-Bolt Split Flange Port to a TEE.

Table 2-9. Connecting a 4-Bolt Split Flange Face to a TEE.

A Flange Face Nom. Size	*B Adapter	C Bushing	D Pipe Nipple	E TEE
1/2	7149		6458	7119
3/4	7150		6459	7120
1	7151		6460	7121
1-1/4	7152	6480	6460	7121
1-1/2	7153	6481	6460	7121

* Use the bolts that connect the line up to the port face.

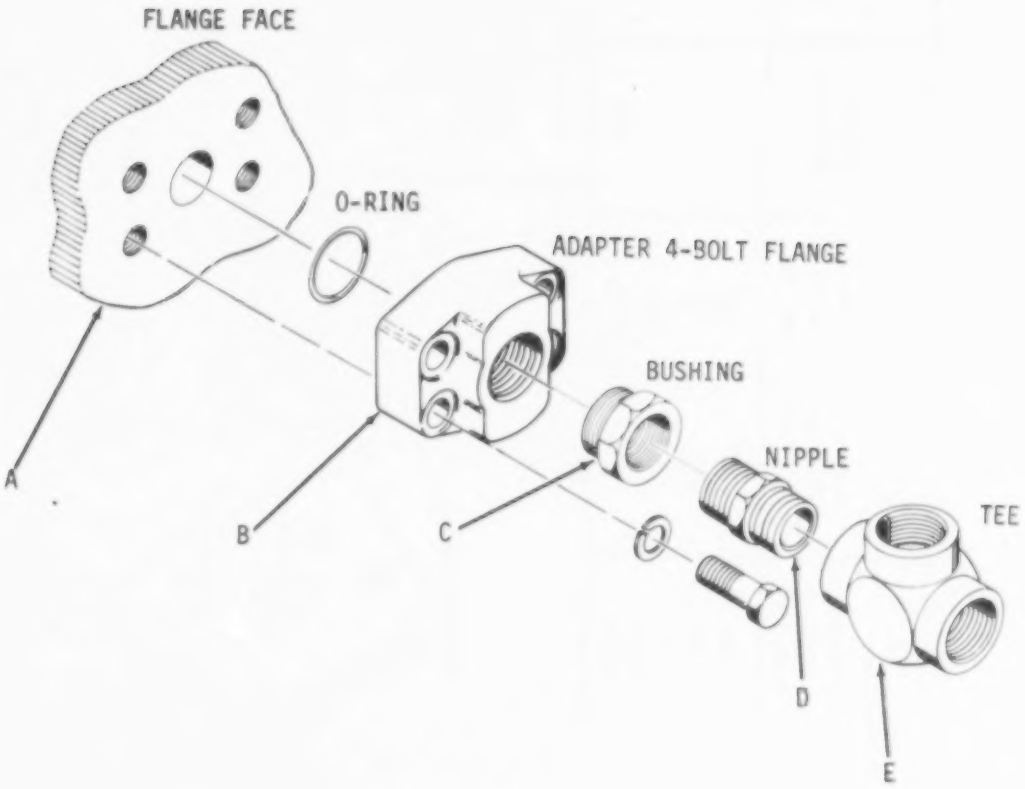


Figure 2-19. Connecting a 4-Bolt Split Flange Face to a TEE.

Table 2-10. Connecting the Hydraulic System Tester to a TEE.

A TEE	B PIPE ADAPTER OR BUSHING	C PIPE ADAPTER OR BUSHING	D PIPE ADAPTER OR BUSHING	E ADAPTER PIPE TO 37° FLARE
7048	7046	7327	6473	MS 51500B16-12
7118	7327	6473	–	MS 51500B16-12
7119	6473	–	–	MS 51500B16-12
7120	–	–	–	MS 51500B16-12
7121	–	–	–	MS 51500B16
6118	6480	–	–	MS 51500B16
7122	6481	–	–	MS 51500B16

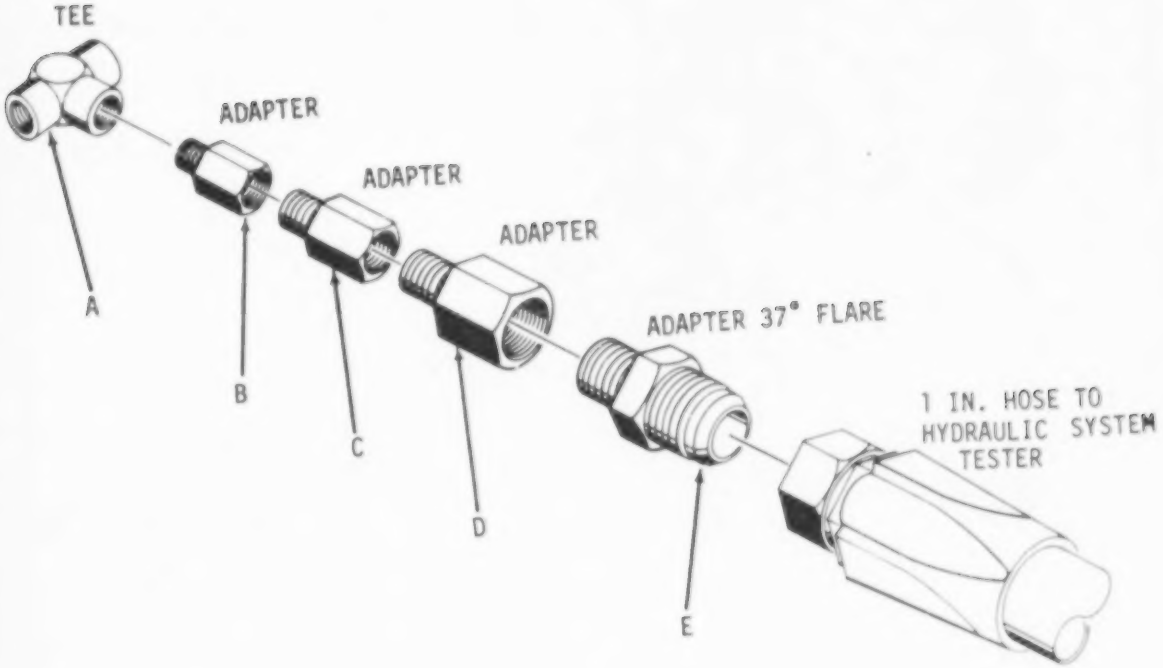


Figure 2-20. Connecting the Hydraulic System Tester to a TEE.

Table 2-11. Connecting the Multigage to the TEE.

A TEE	B Pipe Bushing	C Pipe Bushing	D Pipe Bushing	E Pipe Bushing
7048	6236			
7118	0336	6236		
7119	0746	6236		
7120	0747	6236		
7121	6478	0746	6236	
6118	6479	0747	6236	
7122	6481	6478	0746	6236

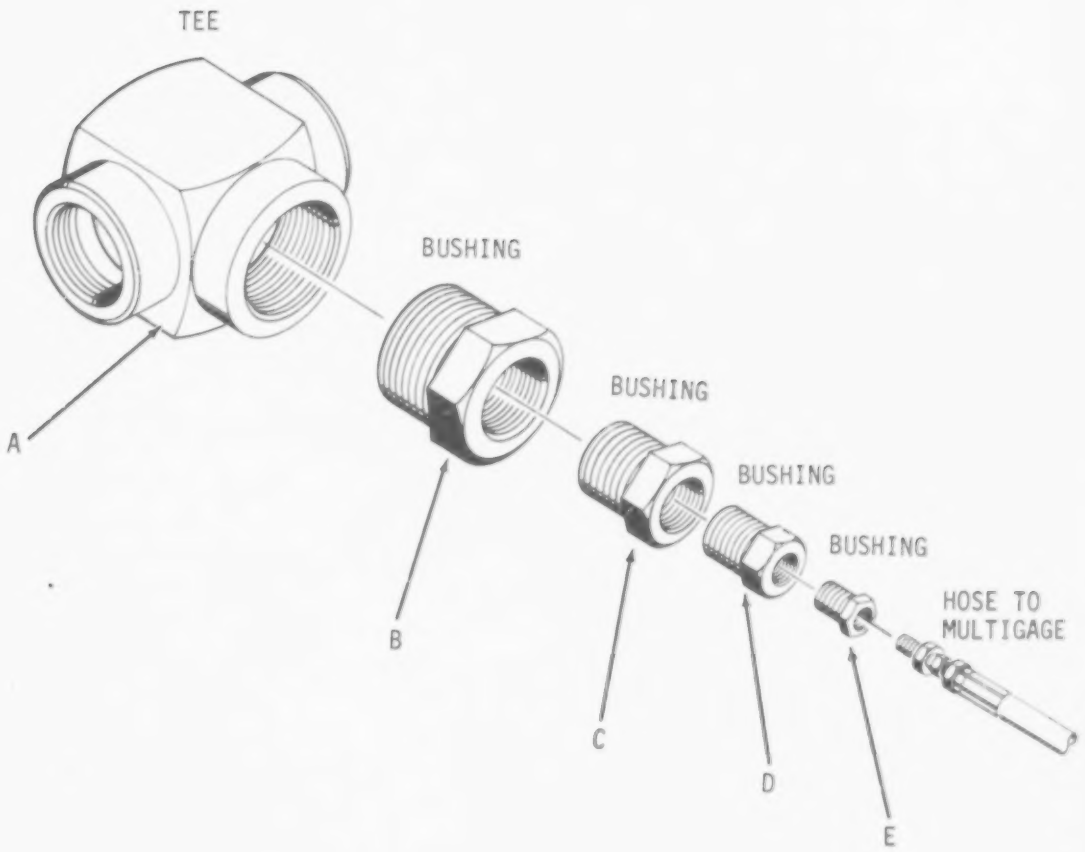


Figure 2-21. Connecting the Multigage to the TEE.

Table 2-12. Connecting a 37 Degree Flare Hose or Tube Assembly to the Proof Pressure Tester.

A Hose To Proof Press Tester 37° Flare	B Adapter 37° Flare	C Bushing	D TEE	E Plug	F Adapter	G Adapter 37° Flare	H Hose or Tube Under Test	I Union	J Cap
3/8	MS 51500B6		7048	6502		MS 51500B4-4	1/4	MS 51501B4	0026
3/8	MS 51500B6		7048	6502		MS 51500B6	3/8	MS 51501B6	0030
3/8	MS 51500B6		7048	6502	7046	MS 51500B8	1/2	MS 51500188	0020
3/8	MS 51500B6		7048	6502	7327 & 7046	MS 51500B12-8	3/4	MS 515001B12	0022
3/8	MS 51500B6	0746	7119	1106	6473	MS 51500B14	7/8	MS 515001B14	0022
3/8	MS 51500B6	0746	7119	1106	6473	MS 51500B16-12	1	MS 515001B16	1371
3/8	MS 51500B6						1-1/4	See Figure 2-22	
3/8	MS 51500B6						1-1/2	See Figure 2-23	

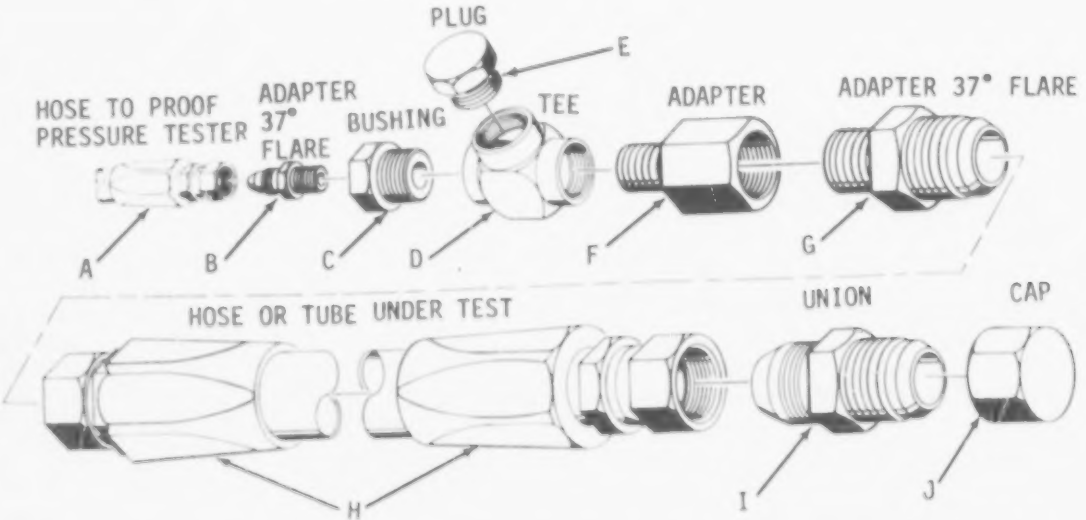


Figure 2-22. Connecting a 37 Degree Flare Hose or Tube Assembly to the Proof Pressure Tester.

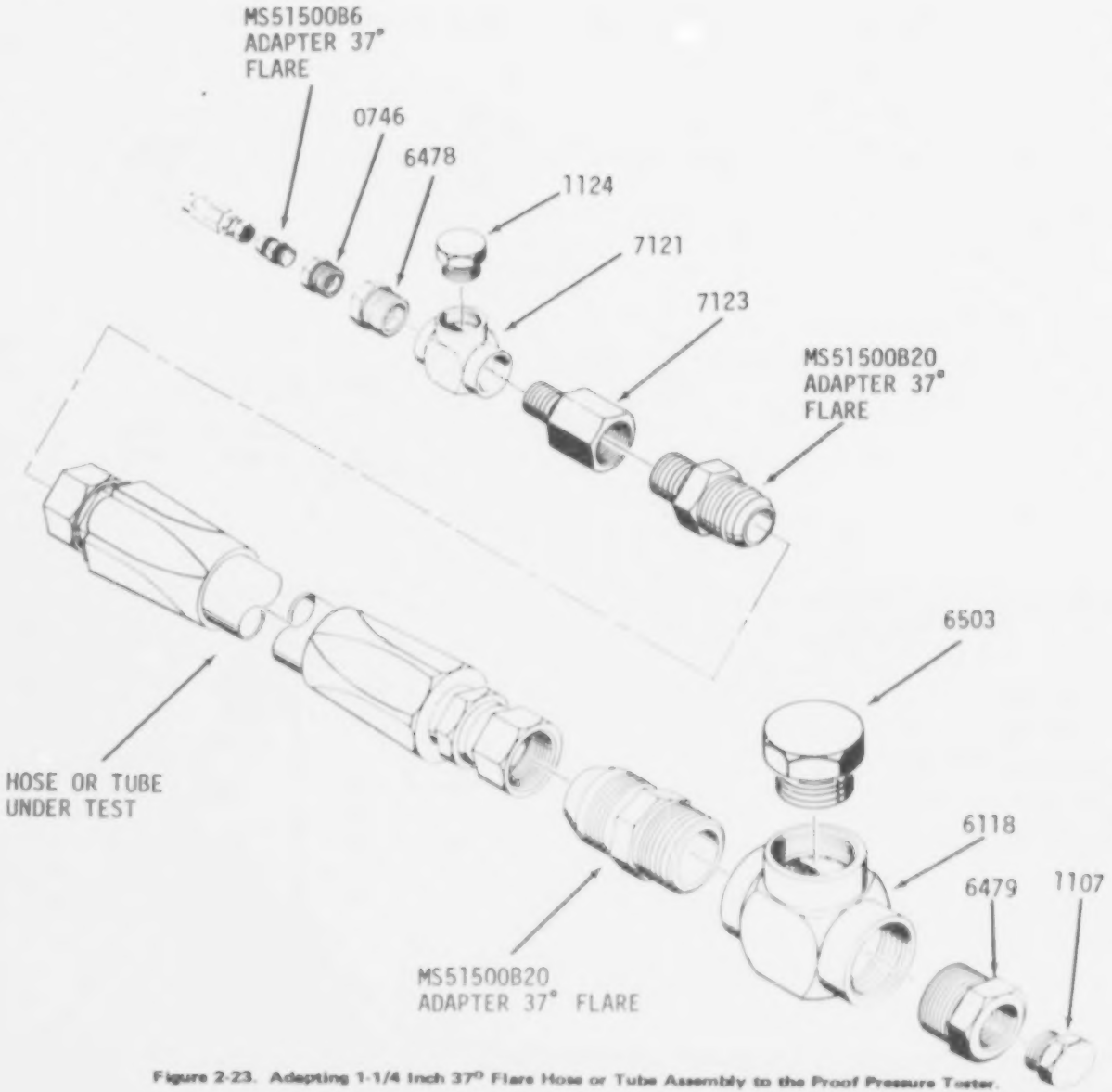


Figure 2-23. Adapting 1-1/4 Inch 37° Flare Hose or Tube Assembly to the Proof Pressure Tester.

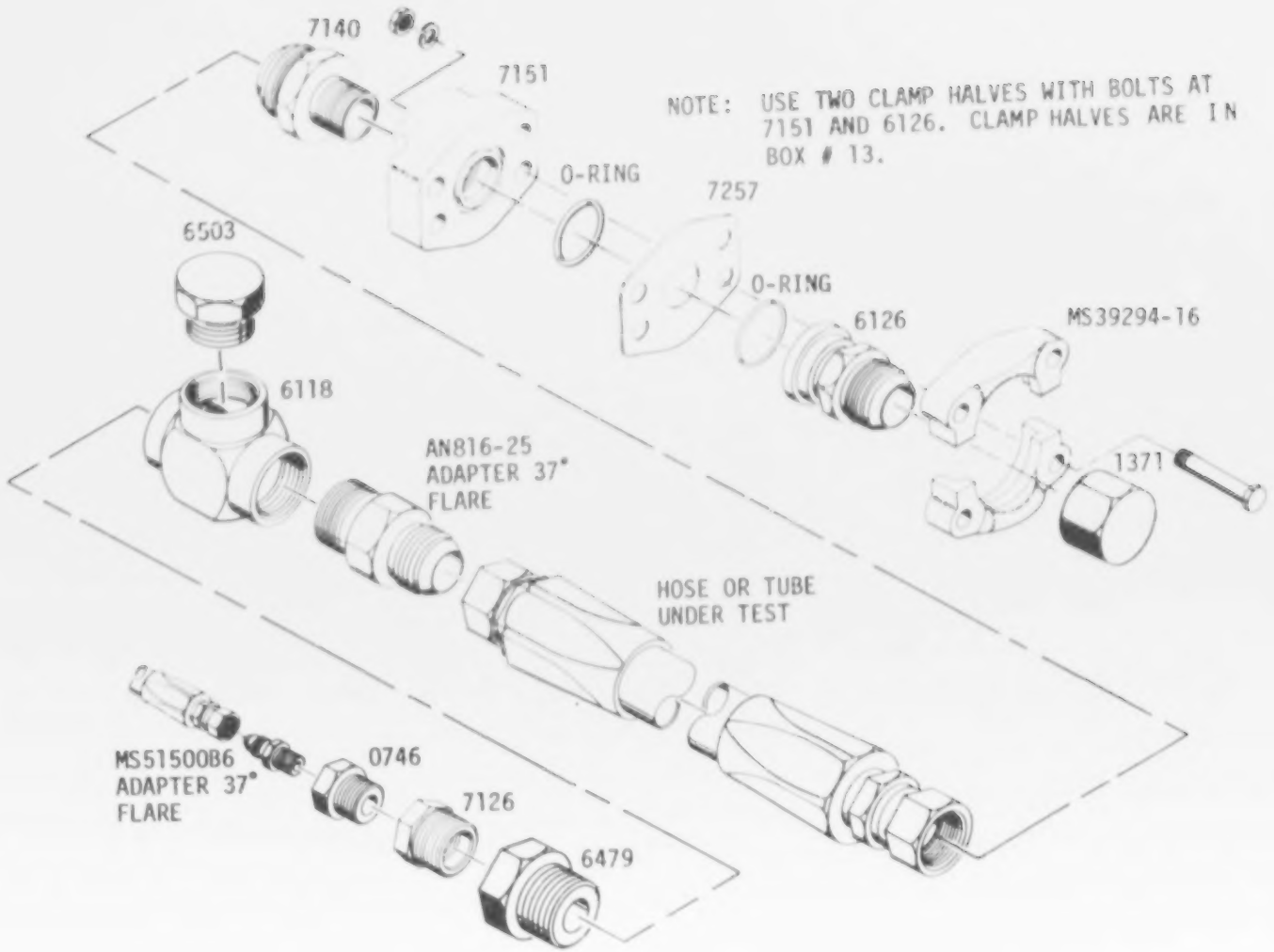


Figure 2-24. Adapting a 1-1/2 Inch 37° Flare Hose or Tube Assembly to the Proof Pressure Tester.

Table 2-13. Connecting a 4-Bolt Split Flange Hose Assembly to the Proof Pressure Tester.

A Hose to Proof Press Tester Flare	B Adapter 37° Flare	C Bushing	D Bushing	E Bushing	F Adapter 4-Bolt Flange
3/8	MS 51500B6	0746			7149
3/8	MS 51500B6	0747			7150
3/8	MS 51500B6	0746	6478		7151
3/8	MS 51500B6	0747	6479		7152
3/8	MS 51500B6	0746	6478	6481	7153

G Connector Plate	*H Clamp Halves	I Hose Under Test	J Connector Plate	K Adapter 4-Bolt Flange to 37° Flare	**L Clamp Halves	M Cap
7255	1/2	1/2	7255	2206	1/2	0020
7256	3/4	3/4	7150	2321	3/4	0022
7257	1	1	7151	6126	1	1371
7258	1-1/4	1-1/4	7152	2322	1-1/4	1371
7259	1-1/2	1-1/2	7153	2325	1-1/2	6338

*Use clamp halves from box no. 13.

**Use clamp halves (2 sets) from old assembly and long bolts with nuts from box no. 13.

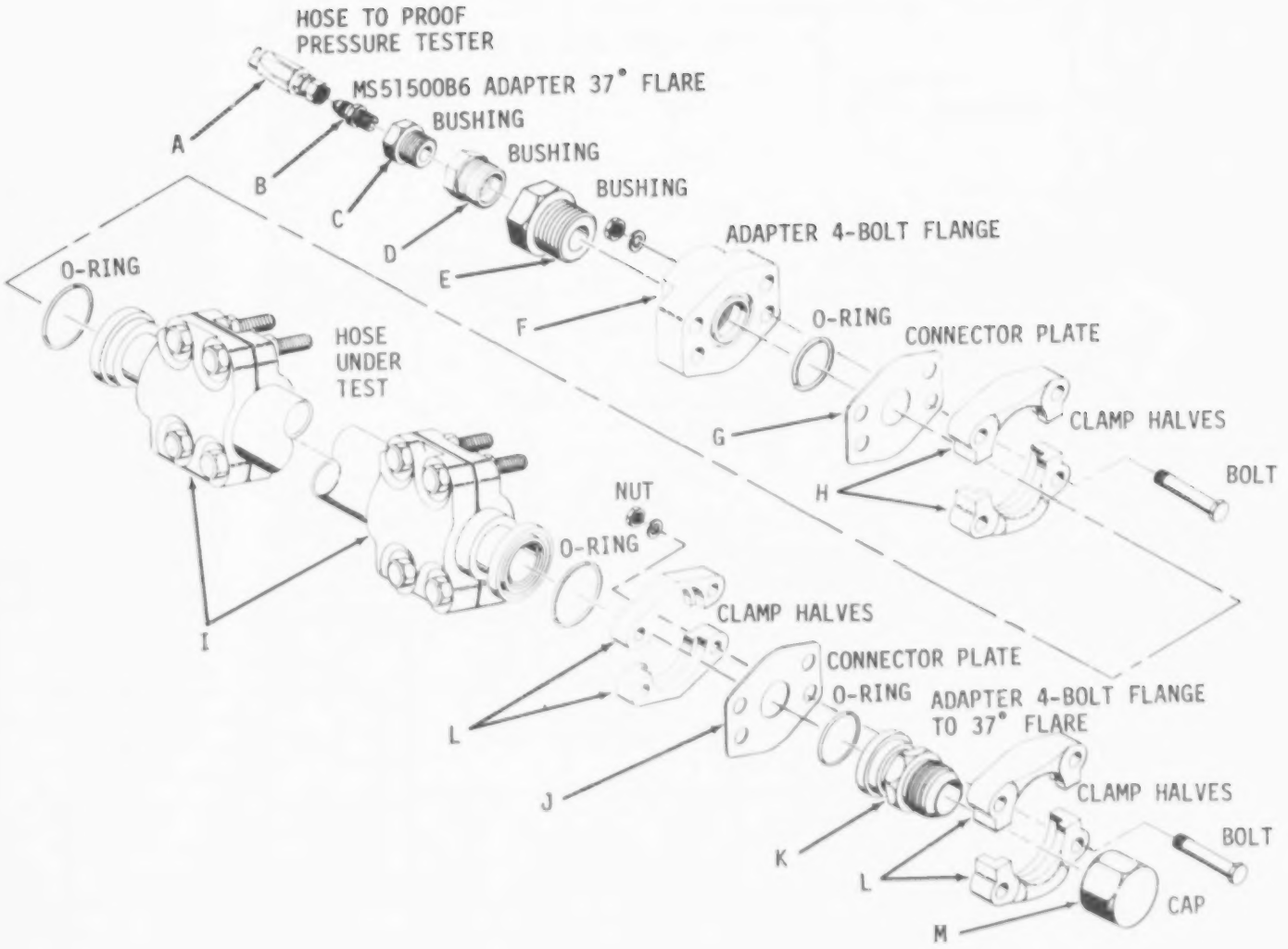


Figure 2-25. Adapting a 4-Bolt Split Flange Hose Assembly to the Proof Pressure Tester.

TM9-4940-488-14

Table 2-14. Adapting a Flareless Tube or Hose Assembly to the Proof Pressure Tester.

A Hose to Proof Press Tester 37° Flare	B Adapter 37° Flare	C Bushing	D Bushing	E Tee	F Plug	G Bushing	H Adapter Flareless	I Hose or Tube Under Test	J Plug/Cap
3/8	MS 51500B6	–	–	7048	6502	6236	7129	1/4	7141
3/8	MS 51500B6	–	–	7048	6502	–	7130	5/16	7142
3/8	MS 51500B6	–	–	7048	6502	–	7131	3/8	7143
3/8	MS 51500B6	0746	–	7119	1106	–	7133	1/2	7144
3/8	MS 51500B6	0746	–	7119	1106	–	7134	5/8	7145
3/8	MS 51500B6	0747	–	7120	1107	–	7135	3/4	7146
3/8	MS 51500B6	0746	6478	7121	1124	–	7136	1	7147

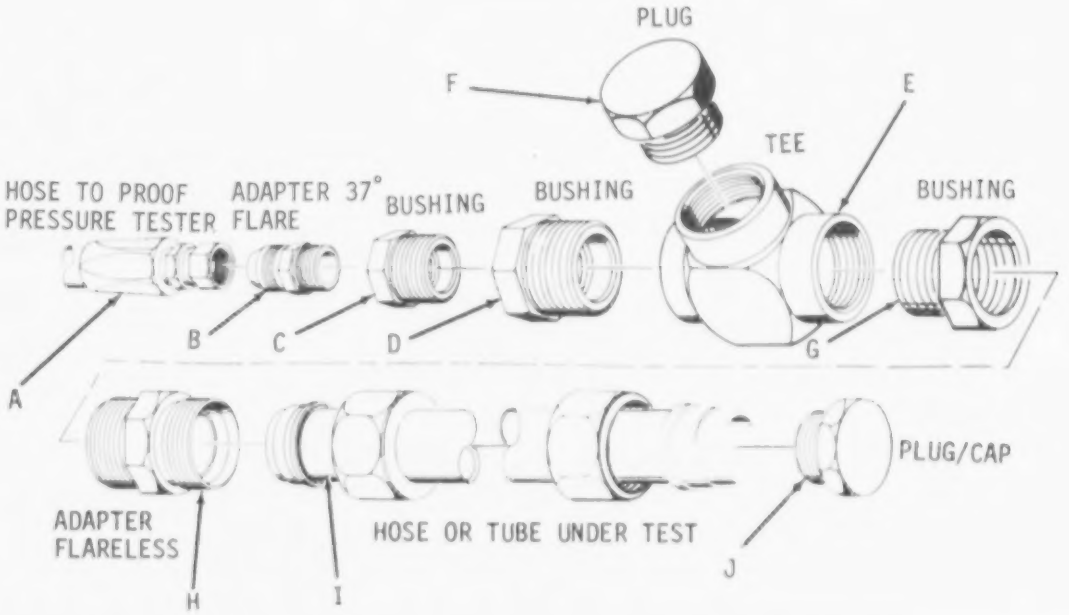


Figure 2-26. Adapting a Flareless Tube or Hose Assembly to the Proof Pressure Tester.

Table 2-15. Adaption of the Flushing Filter to the Return Line.

FLUSHING FILTER TO NPT.

NPT	A Adapter O-Ring	B Bushing	C Nipple	D Bushing	E Adapter
1/4"	6485	6478 and 0746	0706		7327
3/8"	6485	6478	6458		
1/2"	6485	6478	6458	7126	
3/4"	6485	6478	6458		
1"	6485		6460	6480	
1-1/4"	6485	*	6460		
1-1/2"	6485		6462		

NPT TO 4-BOLT FLANGE, TEE, 37° FLARE, OR FLARELESS.

NPT	F Adapter NPT to 4-bOlt Flange	G Connector Plate	H Tee	I Plug	J 37° Flare		K Flareless	
1/4"			7048	6502	1/4"	MS51500B4-4	1/4"	7129
					5/16"	MS51500B5-4	5/8"	7130
							3/16"	7131
3/8"			7118	1105	3/8"	MS51500B6-6	1/2"	7132
1/2"	7149	7255	7119	1106	1/2"	MS51500B8-8	1/2"	7133
					5/8"	MS51500B10	5/8"	7134
3/4"	7150	7256	7120	1107	3/4"	MS51500B12	3/4"	7135
					7/8"	MS51500B14		
1"	7151	7257	7121	1124	1"	MS51500B16	1"	7136
1-1/4"	7152	7258	6118	6503	1-1/4"	MS51500B20	1-1/4"	7137
1-1/2"	7153	7259	7122	**	1-1/2"	AN816-25	1-1/2"	7138

*Use adapters 7123 and 7125.

**Use Bushing 6481 and plug 1124.

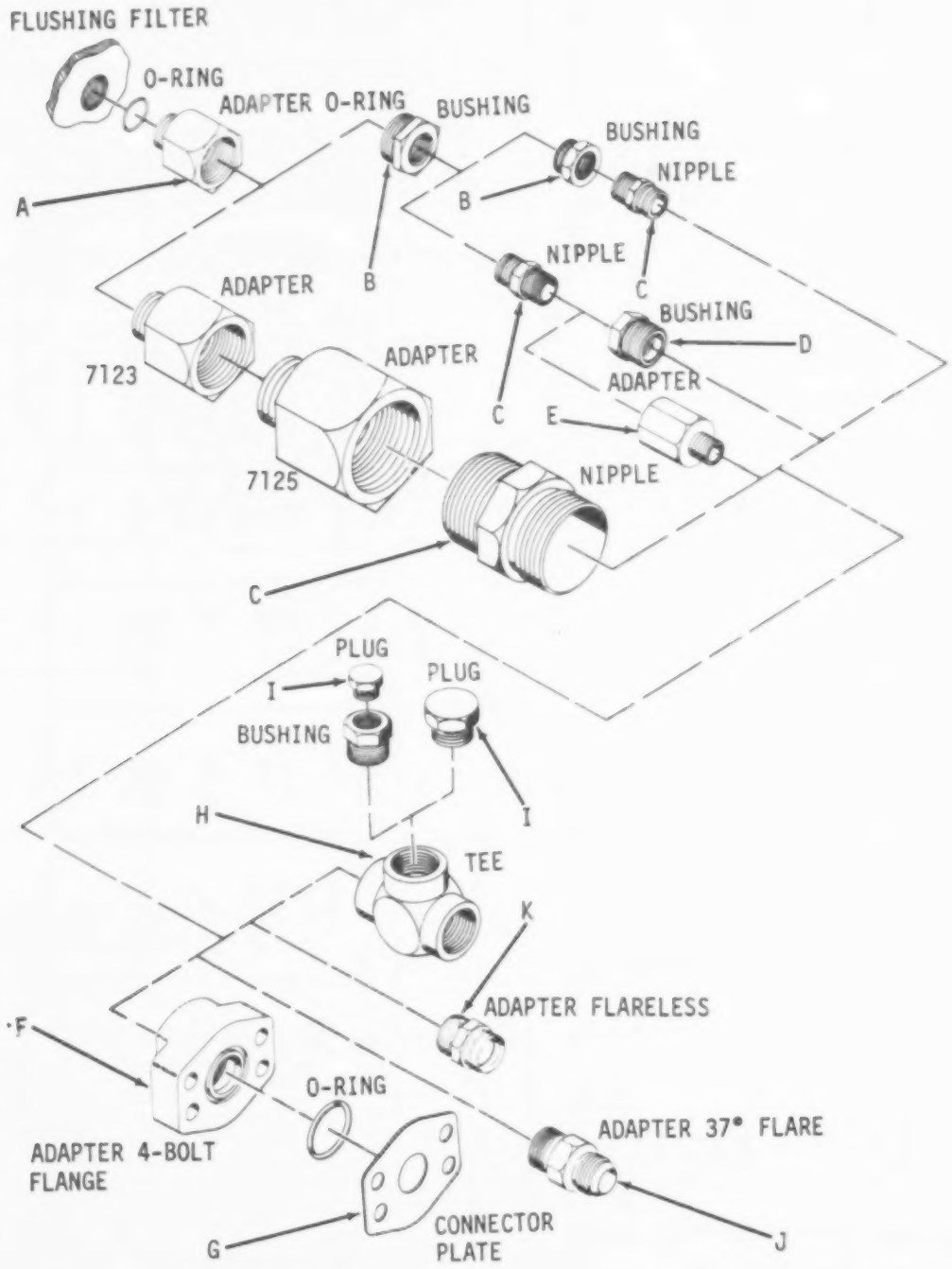
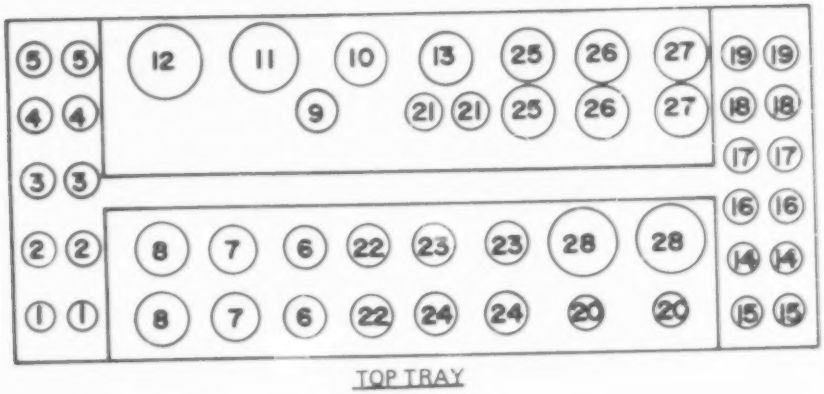


Figure 2-27. Adaption of the Flushing Filter to the Return Line.



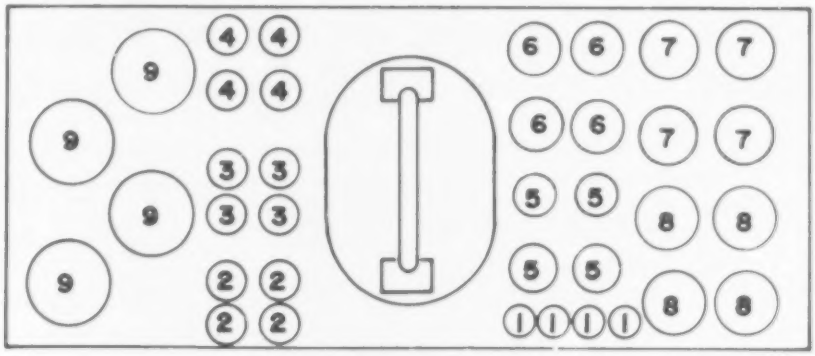
TOP TRAY

MISC. FITTINGS

NO.	SIZE	P/N
	UNIONS	
1	1/4" TUBE	MS51501B4
2	5/16" TUBE	MS51501B5
3	3/8" TUBE	MS51501B6
4	1/2" TUBE	MS51501B8
5	5/8" TUBE	MS51501B10
6	3/4" TUBE	MS51501B12
7	7/8" TUBE	MS51501B14
8	1" TUBE	MS51501B16
9	3/4" TUBE	AN 815-12
	NIPPLES	
10	1" TUBE X 1" NPT	AN816-16
11	1-1/4" TUBE X 1-1/4"NPT	AN816-20
12	1-1/2" TUBE X 1-1/4"NPT	AN816-25
	REDUCER	
13	1" TUBE X 3/4" TUBE	AN919-23

NO.	SIZE	P/N
	ADAPTERS	
14	1/8"NPT X 1/4"TUBE	MS51500B4
15	1/4"NPT X 1/4"TUBE	MS51500B4-4
16	1/8"NPT 5/16" TUBE	MS51500B5-4
17	1/4"NPT X 5/16" TUBE	MS51500B5-4
18	1/4" NPT X 3/8" TUBE	MS51500B6
19	3/8"NPT X 3/8" TUBE	MS51500B6-6
20	3/8"NPT X 1/2" TUBE	MS51500B8
21	1/2"NPT X 1/2" TUBE	MS51500B8-8
22	1/2"NPT X 5/8" TUBE	MS51500B10
23	1/2"NPT X 3/4" TUBE	MS51500B12-8
24	3/4"NPT X 3/4" TUBE	MS51500B12
25	3/4"NPT X 7/8" TUBE	MS51500B14
26	3/4"NPT X 1" TUBE	MS51500B16-12
27	1"NPT X 1" TUBE	MS51500B16
28	1-1/4"NPT X 1-1/4" TUBE	MS51500B20

Figure 2-28. Tube Fitting Kit No. 2 (Sheet 1 of 3)

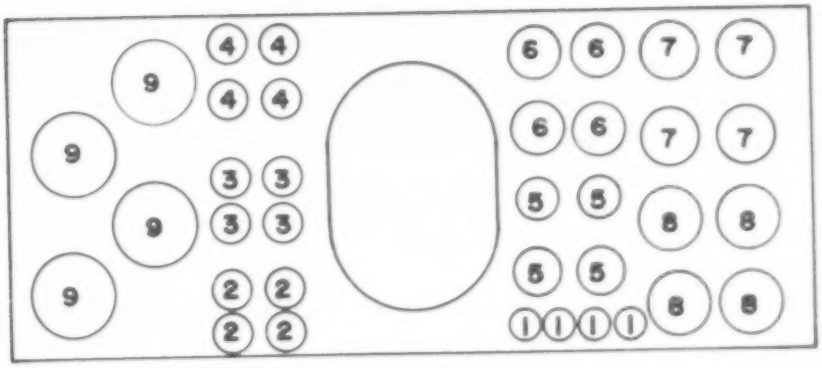


MIDDLE TRAY

FLARELESS FITTINGS

No.	SIZE	NUT P/N	SLEVE P/N
1	1/4" TUBE	MS 51823-3	MS 51825-3
2	5/16" TUBE	MS 51823-4	MS 51825-4
3	3/8" TUBE	MS 51823-5	MS 51825-5
4	1/2" TUBE	MS 51823-6	MS 51825-6
5	5/8" TUBE	MS 51823-7	MS 51825-7
6	3/4" TUBE	MS 51823-8	MS 51825-8
7	7/8" TUBE	MS 51823-9	MS 51825-9
8	1" TUBE	MS 51823-10	MS 51825-10
9	1-1/4" TUBE	MS 51823-11	MS 51825-11

Figure 2-28. Tube Fitting Kit No. 2 (Sheet 2 of 3)



BOTTOM TRAY

37° FLARE FITTINGS

No.	SIZE	NUT P/N	SLEEVE P/N
1	1/4" TUBE	MS 51531 B4	MS 51533 B4
2	5/16" TUBE	MS 51531 B5	MS 51533 B5
3	3/8" TUBE	MS 51531 B6	MS 51533 B6
4	1/2" TUBE	MS 51531 B8	MS 51533 B8
5	5/8" TUBE	MS 51531 B10	MS 51533 B10
6	3/4" TUBE	MS 51531 B12	MS 51533 B12
7	7/8" TUBE	MS 51531 B14	MS 51533 B14
8	1" TUBE	MS 51531 B16	MS 51533 B16
9	1-1/4" TUBE	MS 51531 B20	MS 51533 B20

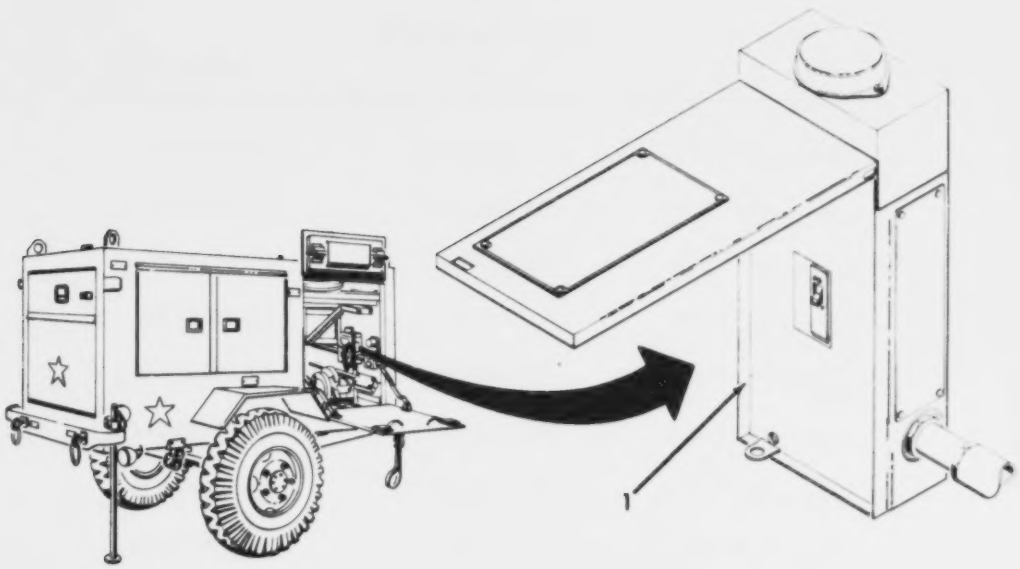
Figure 2-28. Tube Fitting Kit No. 2 (Sheet 3 of 3)

2-22. Preparation for Movement. To prepare the HSTRU for movement, use PMCS 23, 24, 25, 26, 27, and 28.

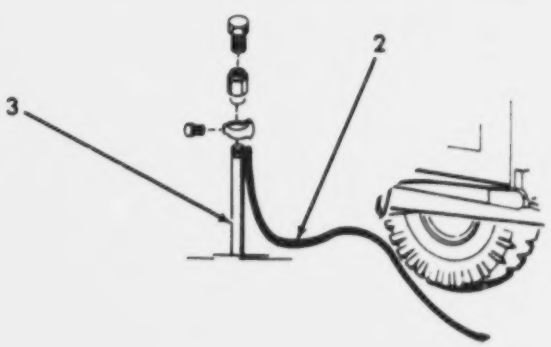
CAUTION

BE SURE ALL TOOLS AND COMPONENTS ARE UNPLUGGED AND ALL SWITCHES ARE IN THE OFF POSITION PRIOR TO REMOVING EXTERNAL POWER.

Place the circuit breaker in the main power panel box (1) to the off position. Disconnect the power cord from the power source. Coil the cord neatly, and stow it in the trailer.



Disconnect the ground wire (2) from the ground stake (3).



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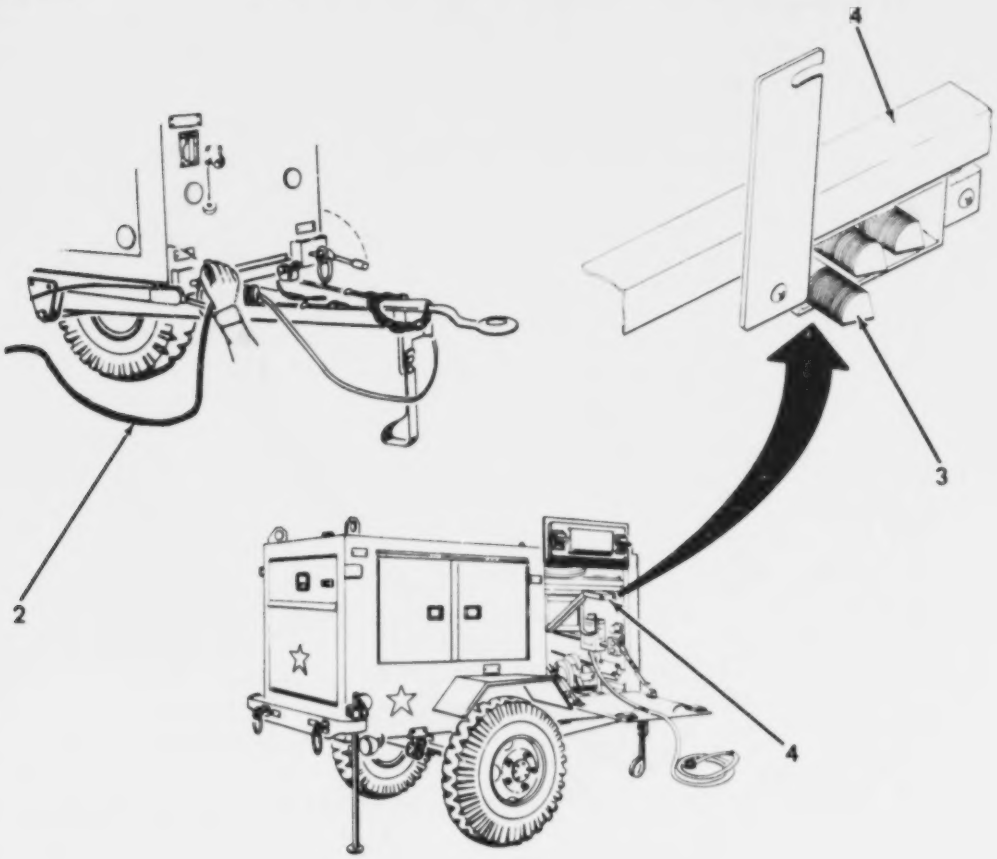
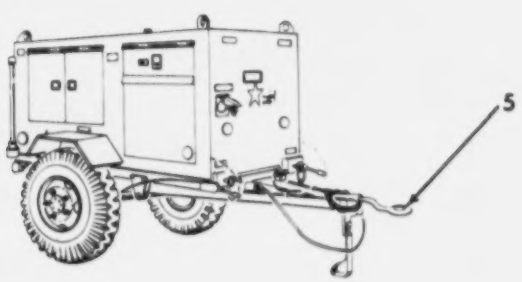
Disconnect the ground wire (2) from the trailer. Coil the ground wire neatly and stow it in the trailer. Remove the ground stake (3) from the ground and clean it thoroughly. Disassemble and stow the ground stake in the ground stake compartment (4).



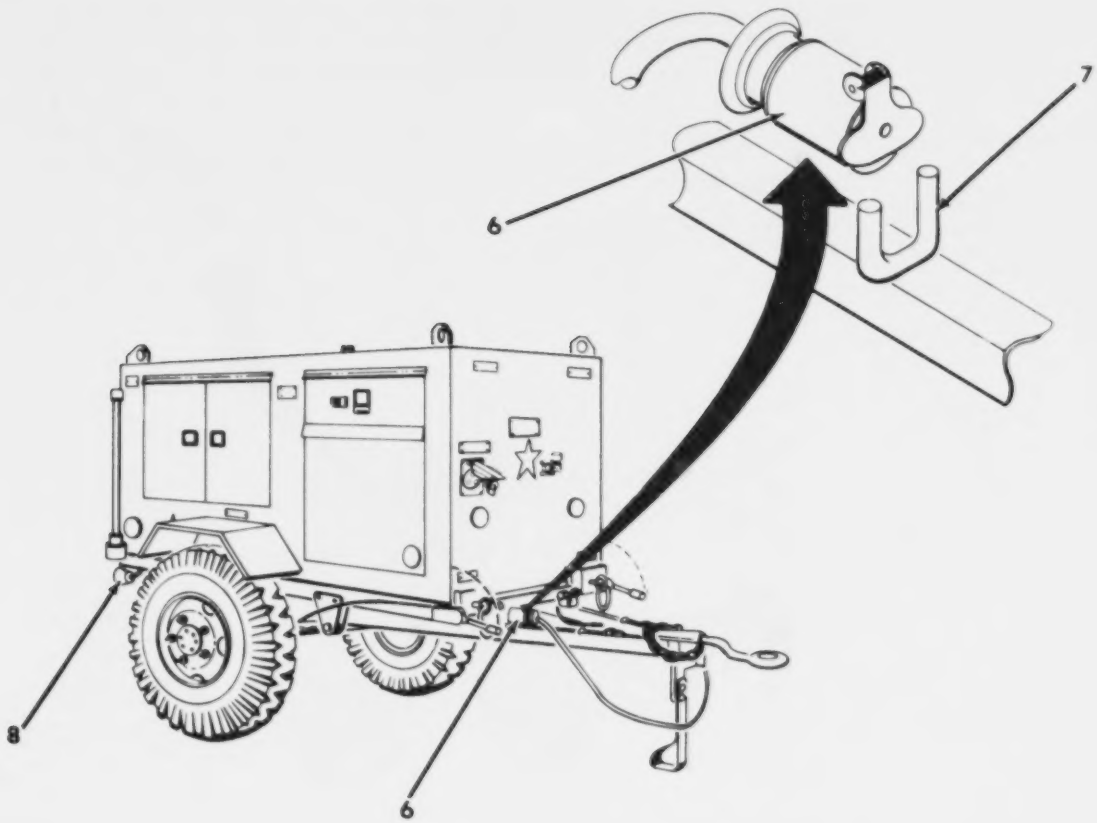
Hook the lunette eye (5) to the tow hitch of the towing vehicle.

NOTE

IF THE TOWING VEHICLE IS EQUIPPED WITH A PINTILE TYPE HOOK, BE SURE TO CLOSE THE UPPER JAW AND INSERT THE SAFETY PIN.



Remove the tail light cable (6) from its stowage bracket (7) and plug it into the towing vehicle's tow cable jack. Check the brake lights and turn signals (8) of the trailer by applying the towing vehicle's brake and turn signals.



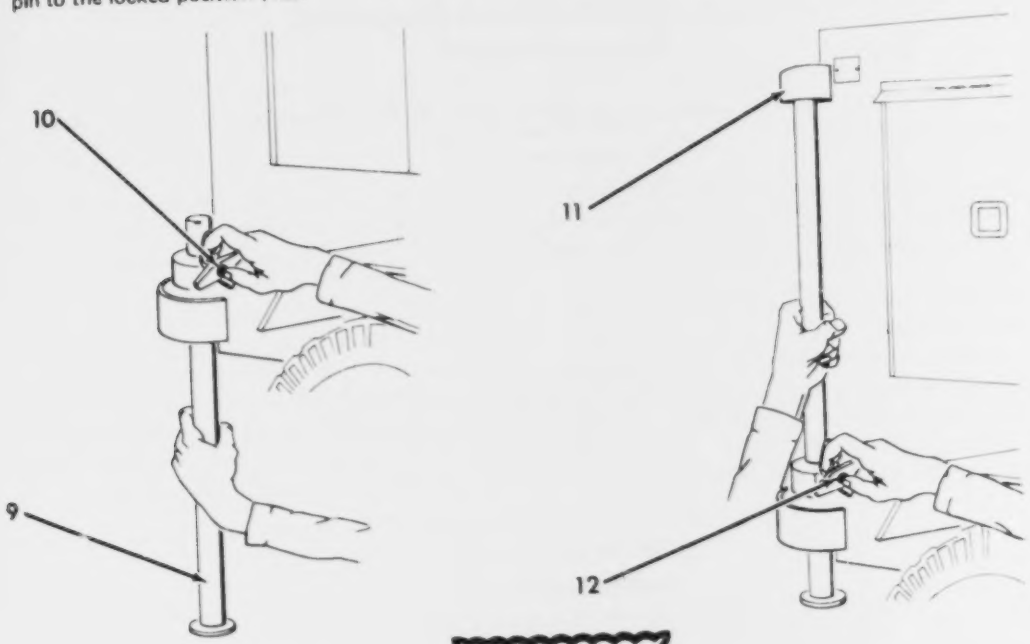
NOTE

THE HSTRU MUST BE CONNECTED TO THE TOWING VEHICLE TOW CABLE JACK BEFORE THE TURN SIGNALS AND BRAKE LIGHTS WILL WORK.

INSPECT THE HSTRU TO ENSURE THAT ALL TOOLS AND SUPPLIES ARE PROPERLY STOWED AND SECURED. BE SURE THAT ALL DOORS ARE CLOSED AND SECURE.

BE SURE THE TAIL LIGHT CABLE IS SECURELY PLUGGED IN.

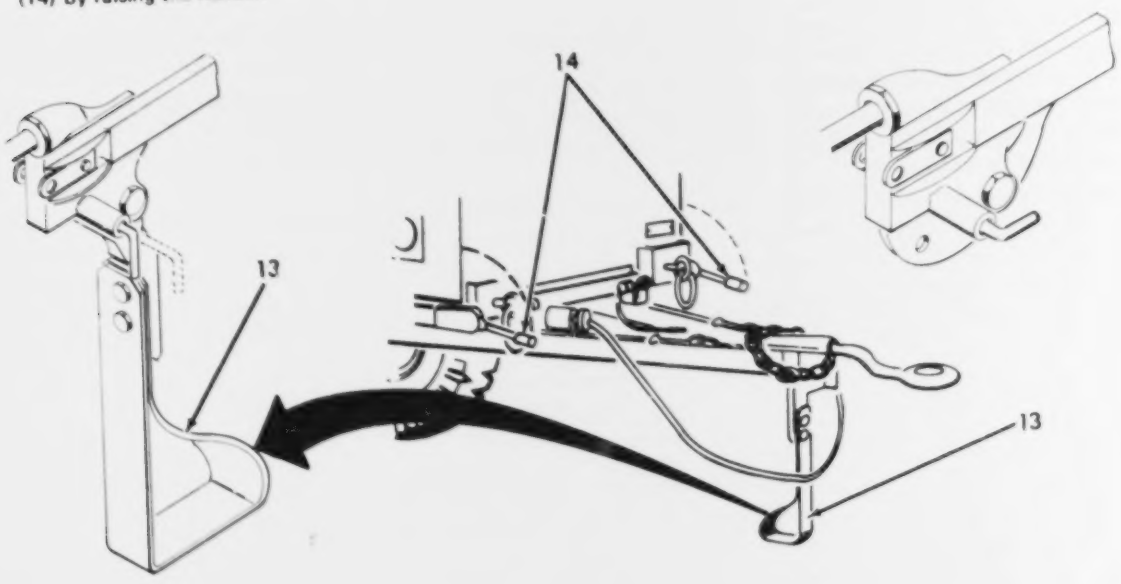
Secure the stablizer leg (9) by removing the pin (10) and pushing the leg up into the storage socket (11). Return the pin to the locked position (12).



CAUTION

MAKE SURE THAT PIN HAS RETURNED TO THE FULL LOCKED POSITION.

Pull out the landing gear leg pin and raise the landing gear leg (13). Lock in place with the pin. Release the hand brakes (14) by raising the handle.



SECTION V

OPERATION UNDER UNUSUAL CONDITIONS

2-23. General. Section IV has described operation of the HSTRU under usual conditions. Section V will describe operation under unusual conditions.

2-24. Operation in Unusual Weather. Weather conditions of extreme moist heat, extreme dry heat, extreme cold, salt air, sea spray, dust storms, sand storms, high altitudes, snow, and mud, or other extreme conditions will affect use of HSTRU. The following paragraphs will describe special precautions which you must take under these conditions.

2-25. Extreme Moist Heat. When operating the HSTRU in conditions of extreme moist heat, be sure that you keep your hands as dry as possible. This will prevent them from slipping and possibly being injured (or causing other injury to you) by power tools. Heavy rainfall is usually associated with climates where extreme moist heat occurs. Take care to avoid contamination of hydraulic oils with rainwater. Be sure not to leave reservoirs uncapped. Another problem which you will encounter in hot, moist climates is an increased equipment corrosion. Extra care must be taken to insure that all components of the HSTRU are kept clean, washed and painted frequently, and inspected regularly. If the area is a jungle type area, all rubber and fabric parts must be carefully inspected to guard against mold and dry rot.

WARNING

DO NOT OPERATE ELECTRICAL TOOLS WHEN IT IS RAINING EXCEPT UNDER COVER.

IF YOU ARE SLIGHTLY INJURED WHILE USING THIS EQUIPMENT IN A HOT, MOIST CLIMATE, OBTAIN MEDICAL CARE. IN EXTREME HEAT AND HUMIDITY EVEN A SLIGHT SCRATCH MAY BECOME ULCERATED AND INFECTED.

Operation procedures are the same as those for normal conditions.

2-26. Extreme Dry Heat. In extreme dry heat, it is very important that you do not become affected by the extreme temperature and lack of humidity. For your own protection, wear gloves before touching metal and try to operate the HSTRU in the shade whenever possible. When operating the HSTRU in extreme dry heat, extra care must be taken to insure that rubber and cloth components do not develop dry rot and that rubber components do not dry out and begin cracking. Care must be taken to assure that the electrical ground is adequate. If practical, pour water around ground rod before using electrical power.

WARNING

WHEN OPERATING THE SAW IN THE SUN, BE VERY CAREFUL NOT TO OVERHEAT THE BLADE.

CAUTION

SEALS MUST BE KEPT LUBRICATED.

2-27. **Extreme Cold.**

WARNING

WHEN OPERATING THE HSTRU IN EXTREME COLD, AVOID SKIN CONTACT WITH HSTRU.

CAUTION

BEFORE YOU OPERATE HYDRAULIC PUMPS IN EXTREME COLD WEATHER, BE SURE THAT THE RESERVOIRS ARE FULL, LINES ARE NOT BLOCKED OR BROKEN AND THE HYDRAULIC OIL IS LOW TEMPERATURE OIL AND FLOWING FREELY.

NOTE

IF TEMPERATURE IS EXPECTED TO FALL BELOW 32°F, APPLY A THIN LAYER OF THE SILICONE LUBRICANT PROVIDED TO ALL DOOR SEAL GASKETS.

IF TEMPERATURES FALL BELOW -25°F, OPERATE IN A HEATED, VENTILATED SHELTER.

2-28. **Salt Air and Sea Spray.** Salt air and sea spray are highly corrosive. When operating the HSTRU or its components be sure to carefully inspect the unit for signs of corrosion on a regular basis. Make every possible attempt to wash the HSTRU regularly with clear water and a mild detergent. Treat any signs of corrosion as soon as possible after their discovery.

2-29. **Duststorms and Sandstorms.** Care should be taken to prevent excessive amounts of dirt and/or sand from collecting in or around any of the operating systems or components of the HSTRU. Pumps, motors, reservoirs, and other hydraulic system components should be kept free of dirt. Special care must be taken to be sure that no sand, dirt, or dust is in the cone, sleeve or dies of the flaring tool.

2-30. **High Altitudes.** Barometric pressure generally decreases as altitude increases. This relationship will cause pressure to build up in closed containers. Care should be exercised when opening closed containers.

2-31. **Snow or Mud.** The stability of the HSTRU is an important consideration when operating it on snow or mud. Consequently, chocking the HSTRU is desirable as well as setting the parking brake and deploying the stabilizer leg. Additionally, care must be taken to prevent dirt and moisture from contaminating HSTRU components and systems.

2-32. **Fording.** No special precautions are required for fords no deeper than the height of the trailer chassis. However, before fording deeper bodies of water, be sure that all possible places where water could enter electrical systems are securely plugged. After fording, do not use tubing or hose which got wet fording until it is thoroughly dried out. Be sure to check all components for water contamination before using them. Tools, tool boxes, tubing and fittings, should be thoroughly dried and wiped down with a general purpose, corrosion preventive lubricant after fording.

CAUTION

CHECK ALL ELECTRICAL COMPONENTS FOR ENTRY OF WATER. DRY OUT AS NECESSARY AND HAVE CHECKED BY AN ELECTRICIAN FOR POSSIBLE PROBLEMS.

2-33. Emergency Procedures. The normal mode of operation for the HSTRU is with external power applied. However, sufficient hand tools and tools not requiring electrical power have been provided to permit you to continue to operate the HSTRU without electrical power. The following paragraphs describe how you can continue to function effectively with the HSTRU even though electrical power is not available to you.

2-34. Hose Cutting. To cut hose when electrical power is not available, simply select the proper stock, measure it and mark it, just as you would if you were going to use the power saw. Clamp the hose securely in the machinists vise on the aft work table and cut it with the hacksaw with the abrasive blade which has been included in your hand tools. Wash the hose by draining solvent from the reservoir and pouring through the hose. Be sure to remove all dirt generated during cutting as this material is extremely harmful to hydraulic systems.

NOTE

BE SURE TO CUT THE HOSE AT RIGHT ANGLES TO ITS CENTERLINE.

2-35. Hose Coupling Assembly. Hose coupling assembly may be accomplished with a vise and wrenches when electrical power is not available. Clamp the hose securely in the vise. Push the hose socket onto the hose and turn in a counterclockwise direction. Clamp the socket (with hose) in the vise. Lubricate the nipple and turn it into the socket by turning clockwise.

NOTE

LUBRICATE THE I.D. OF THE HOSE BEFORE INSERTING THE NIPPLE.

2-36. Tube Preparation. The tools associated with hydraulic tube preparation may be used without electrical power. The tube bender is powered by the mechanical action of its crank (see paragraph 2-11c) and the tube flaring tool is actuated by hydraulic pressure developed by the hand pump.

2-37. Tools Requiring Electrical Power. The hose cutting saw, the hose coupling assembler, and the impact wrench require electrical power.

CHAPTER 3

OPERATOR'S AND ORGANIZATIONAL MAINTENANCE INSTRUCTIONS

SECTION I

REPAIR PARTS, SPECIAL TOOLS, AND EQUIPMENT

3-1. Special Tools and Equipment. No special tools or equipment are required for maintenance of the HSTRU.

3-2. Repair Parts. Repair parts are listed and illustrated in TM9-4940-468-24P. This is the repair parts list covering maintenance of this equipment.

SECTION II

LUBRICATION ORDER

3-3. General Lubrication Information. This section contains supplemental cleaning and lubrication instructions, refer to Lubrication Order (fig. 3-1) for HSTRU lubrication points, and TM9-2330-202-14P for Trailer chassis. Keep all lubricants in closed containers and store in a clean, dry place away from external heat. Allow no dust, dirt, or other foreign material to mix with the lubricants. Keep all lubrication equipment clean and ready for use. Keep all external parts not requiring lubrication clean of lubricants. Before lubricating the equipment, wipe all lubrication points free of dust and grease. After lubrication, wipe off excess lubricant to prevent accumulation of foreign matter.

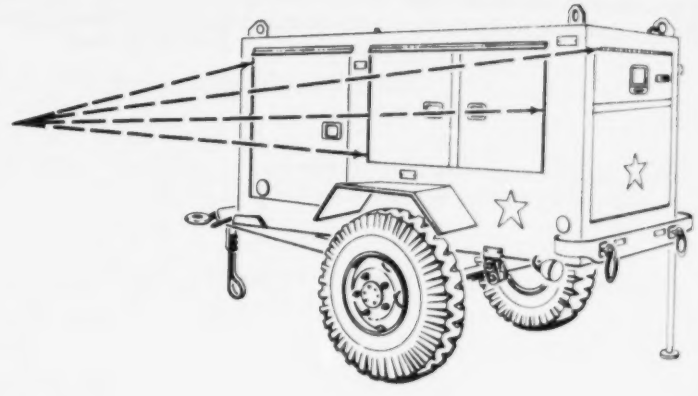
LUBRICATION ORDER

LO 9-4940-468-14

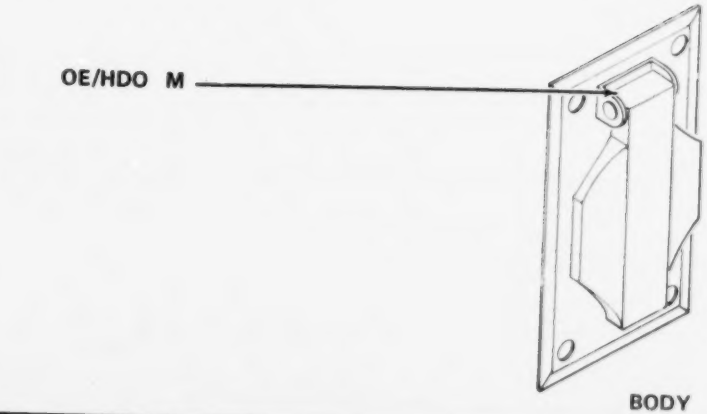
TOOL OUTFIT, HYDRAULIC SYSTEMS TEST AND REPAIR (HSTRU)

General Notes. Intervals and the related manhour times are based on normal operation. The manhour time specified is the time you need to do all the services prescribed for a particular interval. Change the interval if your lubricants are contaminated or if you are operating the equipment under adverse operating conditions, including longer-than-usual operating hours. You may extend the interval during periods of low activity, but you must take adequate preservation precautions. Clean fittings before lubricating. Clean parts with paint thinner, volatile mineral spirits (EPM), or solvent, dry cleaning (SD). Dry before lubricating. Dotted arrow points indicate lubrication on both sides of the equipment. Do not over lubricate; wipe off excess lubricant. The lowest level of maintenance authorized to lubricate a point is indicated by one of the following symbols as appropriate: Operator/crew (C); and Organizational Maintenance (O).

LUBRICANT • INTERVAL



Door Hinges (0) **OE/HDO M**



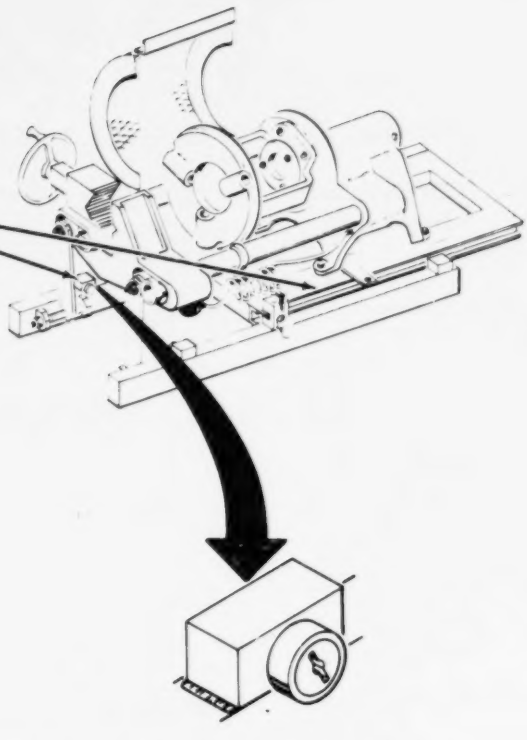
Receptacle Cover Springs (0) **OE/HDO M**

BODY

Figure 3-1. Lubrication Order (Sheet 1 of 5).

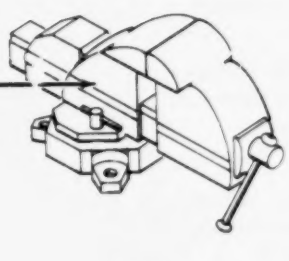
LUBRICANT • INTERVAL

Sliding Tool Rack and Rollers (0) OE/HDO M



BODY

Screw (Clean and lubricate) (0) OE/HDO M



VISE

Figure 3-1. Lubrication Order (Sheet 2 of 5).

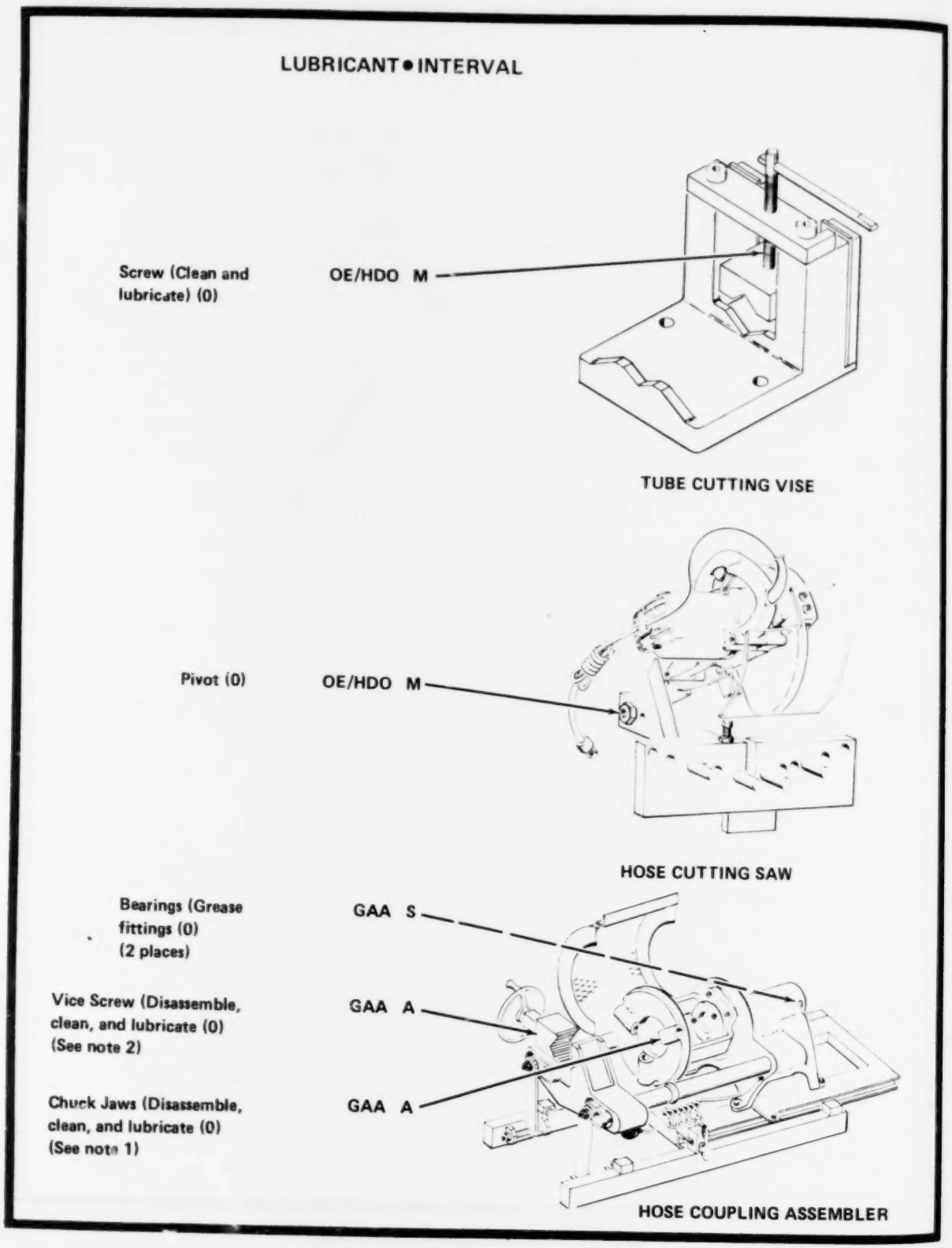


Figure 3-1. Lubrication Order (Sheet 3 of 5).

TOTAL MAN–HOURS	
INTERVAL	MAN-HOURS
M	1.5
S	.3
A	2.0

KEY

LUBRICANT		EXPECTED TEMPERATURE			Arctic operations; TM9-207	INTERVAL
		Above + 32° F	+40° F to -10° F	0° F to -65° F		
OE/HDO (Mil-L-2104)	Lubricating oil, internal combustion engine	OE/HDO–30	OE/HDO-10	OES		A-ANNUALLY S-SEMI-ANNUALLY M-MONTHLY
GAA (Mil-G-10924)	Grease, automotive and artillery	ALL TEMPERATURES				

NOTE:

1. **CHUCK JAWS.** To disassemble, first scribe each of the three jaws so that it may be replaced in exactly the same location and position (each jaw is different). Then remove six screws (1) and the jaw assembly will come apart. Wash the parts in solvent and allow them to dry. Then lubricate and reassemble. Be sure that the scribe marks are aligned as the parts are mated together.

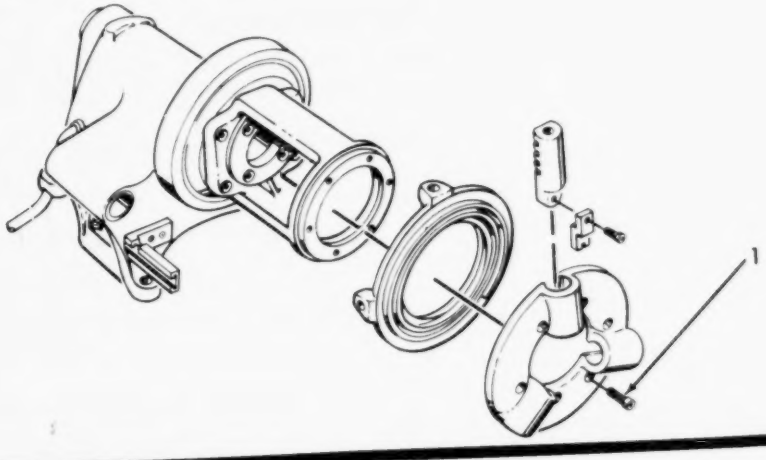
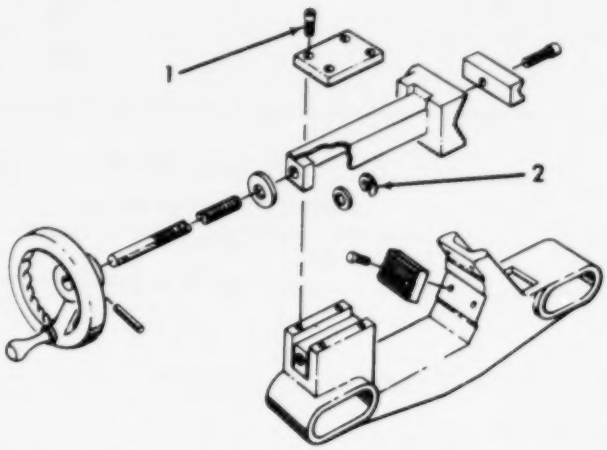


Figure 3-1. Lubrication Order (Sheet 4 of 5).

2. VISE SCREW. To disassemble, loosen the set screws and remove two collars and the vise from the tool. Remove four screws (1) and retaining ring (2). Screw the handwheel and shaft out.



Wash the parts in solvent and allow them to dry. Then lubricate and reassemble.

Figure 3-1. Lubrication Order (Sheet 5 of 5).

SECTION III

TROUBLESHOOTING

3-4. Introduction. This manual does not list all malfunctions that may occur, or all tests or inspections and corrective actions. If a malfunction is not listed or is not corrected by listed corrective actions, notify your supervisor.

3-5. Troubleshooting Table. The table lists the common malfunctions which you may find during the operations or maintenance of the HSTRU or its components. You should perform the tests, inspections, and corrective actions in the order listed.

TROUBLESHOOTING TABLE

1. **Parking brake will not engage.**

   Step 1. Check to see if brake cables are broken.
   Repair/replace brake cables IAW TM9-2330-202-14 & P.

2. **No electrical power to unit, external power hooked up.**

   Step 1. Check to see if external power supply source is operating correctly.
   Notify external power supply source operator.

   Step 2. Check to see if the external power cable is plugged in.
   Plug it in.

   Step 3. Check to see if the circuit breaker is in the "on" position.
   Turn breaker on.

   Step 4. Check to see if power is now on.

3. **Hose Cutting Tool (power saw) will not operate (no power).**

   WARNING

   KEEP CLEAR OF THE SAW BLADE DURING ALL PHASES OF TROUBLESHOOTING THIS TOOL.

   Step 1. Check to see that the power switch is completely depressed.
   Depress Switch

   Step 2. Check to see that the saw is securely plugged in.
   Tighten plug.

   Step 3. Check to see that power has reached the electrical outlet.
   Go to Item 2, Step 1.

4. **Hose Cutting tool (power saw) blade will not rotate.**

CAUTION

DO NOT ATTEMPT TO OPERATE THE SAW WHEN THE BLADE IS BINDING.

Step 1. Unplug saw. Check to see that the saw blade is not bound up by some foreign object or other part of the saw. Free the blade.

Step 2. Check to see that power is available to the tool. Check plug, turn power on.

Step 3. Check to see if the motor brushes are operable. Replace the brushes.

5. **Hose Coupling (fitting) Assembler will not operate.**

Step 1. Check to see that the power switch is not in the "off" position.

CAUTION

IF TOOL MAKES PERIODIC NOISE AND SEEMS TO SLIP, TURN IT OFF. PROBABLE CAUSE IS GEAR TRAIN DAMAGE. REPAIR/REPLACE GEARS.

Turn switch on.

Step 2. Check to see that the tool is securely plugged in.
Tighten plug.

Step 3. Check to see that power has reached the electrical outlet.
Go to Item 2, step 1.

6. **Tube Bender binds or distorts tubing.**

Step 1. Check to see that the tube being bent is not larger than the maximum diameter which the installed radius block is designed to bend.
Install correct radius block.
Clean block, vise, and channel.
Turn the crank at slow, steady speed.

7. **Tube flaring tool does not operate.**

Step 1. Check Hand Pump Valve to see that it is closed.

Step 2. Check the hand pump and see that the reservoir is full.
Fill reservoir.

Step 3. Cap the pump outfit line and check pump pressure.

Step 4. Check the tube flaring tool for leaks.
Replace tool.

Step 5. Check the pump output line for leaks and/or loose fittings.
Repair/replace as necessary.

Step 6. Check the tube flaring tool to see if the collar is moving.
Replace tool.

8. **Transfer pump will not pump oil, electric motor not running.**

Step 1. Check to see that the pump is plugged in.
Plug pump in.

Step 2. Check to see that the pump switch is in the "on" position.
Turn switch "on".

Step 3. Check to see that the receptacle has power. Check with another electrical tool.
Go to Step 4.

Step 4. Check to see that there is power to HSTRU.
External power source operating correctly, HSTRU properly plugged in, and circuit breakers in the "on" position.

9. **Transfer pump will not pump oil, motor running.**

Step 1. Check the inlet hose to see if it is plugged.
Remove whatever is blocking the hose.

Step 2. Check to see that the hose is submerged in oil.
Submerge the inlet hose.

Step 3. Check to see that the inlet hose is the proper size.
Install correct hose.

Step 4. Check to see that the pump is not too high above the reservoir level.
Position the unit closer to the reservoir.

10. **Transfer pump output low.**

Step 1. See step 1, item 9.

Step 2. See step 3, item 9.

Step 3. See step 4, item 9.

Step 4. Check the outlet hose to see that it is the proper size.
Install correct hose.

Step 5. Check the filter element indicator to see if the filter element is clogged.

Step 6. Check the TM of the system you are servicing to see if the oil is correct for the ambient temperature.

Step 7. Check the pump for evidence of wear and/or leaks.
Replace pump.

11. No pump pressure, hand pump.

Step 1. Check to see if the load relief valve is open.
Close valve and pump pressure up.

Step 2. Check the reservoir to see that it is properly serviced.
Service reservoir.

Step 3. Inspect all lines and fittings from the pump for leaks.
Repair/Replace.

Step 4. If still no pump pressure: replace pump.

12. No pump pressure, wash pump.

Step 1. Check to see that the pump electrical plug is plugged in tightly.
Tighten plug.

Step 2. Check to see that the electrical outlet has power.
Troubleshoot electrical system.

Step 3. Check the reservoir to see that it is properly serviced.
Service reservoir.

CAUTION

DO NOT OPERATE THIS PUMP WHEN THE RESERVOIR IS NOT FULLY SERVICED.

Step 4. Check all lines and fittings to and from the pump for leaks.
Repair/Replace.

Step 5. If still no pressure, check pump.
Replace pump.

13. Pressure gage on hydraulic system tester does not register when load valve handle is depressed and flow gage reading is below zero.

Step 1. Check inlet and outlet connections to be sure they are not reversed.
Connect inlet and outlet ports correctly.

14. Flow gage on hydraulic systems tester "freezes" in any position.

Step 1. Check the return line for excessive back pressure.

CAUTION

RETURN LINE BACK PRESSURE MUST NOT EXCEED 100 PSI.

Choose proper orifice.

15. Oil audibly released into the hydraulic system tester case.

Step 1. Check inlet and outlet connections to be sure they are not reversed.
Connect inlet and outlet ports correctly.

Step 2. Check blowout plug to see if it has ruptured.
Replace blowout plug.

SECTION IV

MAINTENANCE INSTRUCTIONS

3-6. General. This section describes repair and replacement procedures used on the HSTRU at the operator's and organizational levels of maintenance.

3-7. HSTRU Body. The following paragraphs describe trailer body maintenance which is performed at the operator's and organizational levels of maintenance.

a. Inspect. Determine the serviceability of the trailer doors, fenders, stabilizer legs, reflectors, identification plates, lifting eyes, shelving, sliding rack, and radius block pins by visually inspecting them for cracks, dents, serviceability, corrosion, popped or missing rivets or screws or any other deficiencies. See items 5, 6, 7, 10, and 12 of your (B) PMCS for inspection procedures.

b. Service. Some parts of the trailer body require periodic servicing to keep them in proper operating condition. Use the following procedures for servicing.

(1). Doors. Door hinges and latches should be lubricated monthly with a good grade of general purpose oil. This will help ensure smooth operation and prevent corrosion.

(2). Sliding Racks. The sliding rack should be cleaned and lubricated periodically. Remove any visible foreign objects which might cause the rack to jam. Lubricate the rollers and sliding surfaces of the sliding rack.

(3). Radius Block Pins. Be sure that the radius block pins are tightly installed. If they are not, screw them in.

c. Replace. If you discover any trailer body components unserviceable, replace them according to the following procedures.

(1). Stabilizer Leg. Use the following procedure to remove and replace the stabilizer leg.

(a). Be sure the parking brake is engaged.

WARNING

USE PROPER BENDING AND LIFTING TECHNIQUES.

(b). Raise the forward landing leg and gently lower the lunette eye to the ground. Permit the trailer to rest on the lunette eye.

CAUTION

HOLD THE LEG TO PREVENT IT FROM FALLING TO THE GROUND.

(c). Remove the pin from the stabilizer leg collar and remove old leg.

(d). Insert the new leg by pushing it up through the collar to the stabilizer leg stop.

(e). Reinsert the pin in the collar, through the leg.

(f). Lift the lunette eye off the ground.

(g). Deploy the forward landing leg.

(2). Reflectors, Identification Plates, or Lifting Eyes. Replacing reflectors, identification plates, or lifting eyes is simply a matter of removing the screws which hold them in place, removing the object, placing a new one in position, and reinstalling the screws. Replace screws which are scored, have stripped heads, or flattened threads.

CAUTION

DO NOT OVERTORQUE. TIGHTEN SCREWS SECURELY BUT DO NOT ATTEMPT TO TIGHTEN THEM PAST THE POINT WHERE YOU CAN'T BREAK THEM LOOSE USING ONLY ONE HANC ON THE SCREWDRIVER.

(3). Radius Block Pins. The radius block pins are threaded on the end and may be removed by unscrewing them from the HSTRU bulkhead. New radius block pins may be installed by simply screwing them in.

d. Repair. The only repair authorized on the HSTRU body at the operator or organizational maintenance level is repair of the HSTRU doors. Most repairs of the doors may be accomplished with the doors still mounted on the HSTRU. Among the repairs which may be accomplished while the door is still on the trailer are replacement and repair latches and handles, replacement of popped or missing rivets, corrosion control treatments, and welding of cracks which do not exceed two inches in length.

3-8. Electrical Distribution System. Operator and organizational maintenance of the electrical distribution system consists of inspecting the components.

a. Breaker Box. Inspect for moisture, corrosion and physical damage.

b. Circuit Breaker. Inspect the circuit breaker for cracks or chips. Turn it on and off to see that it will move and will stay in position selected. Using the instructions in the PMCS, apply electrical power to the HSTRU.

WARNING

BE SURE THE HSTRU IS PROPERLY GROUNDED BEFORE APPLYING ELECTRICAL POWER.

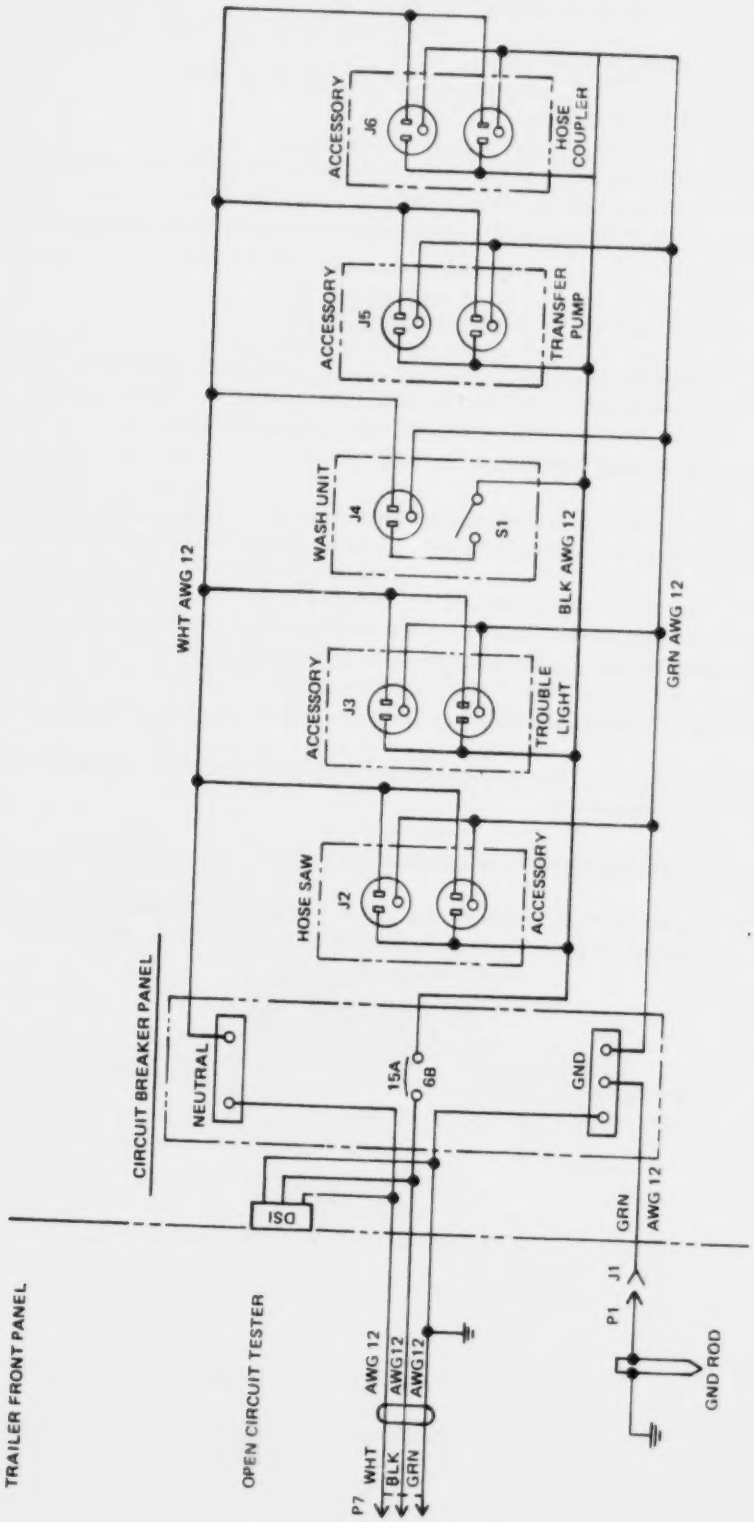


Figure 3-2. Electrical System Schematic.

To test the circuit breaker apply electrical power to the HSTRU. Place the breaker in the "on" position. Use a power tool or outlet tester if available to see if there is power to the outlet.

WARNING

IF YOU USE A POWER TOOL TO TEST FOR ELECTRICAL POWER, BE SURE TO OBSERVE ALL THE WARNINGS AND CAUTIONS WHICH APPLY TO THAT TOOL.

Figure 3-1 is a diagram of the electrical system.

c. Electrical Connectors. Inspect all the electrical connectors to be sure they are securely installed.

d. Electrical Outlets and Switches. Inspect all electrical outlets to see that the outlet covers fit securely and that the springs which close the outlet covers operate correctly. Check the outlets with an outlet tester if available, or a power tool.

e. Electrical Lines. Inspect all electrical wiring and conduits. Look for broken or frayed wiring. Look for worn or missing insulation. Check conduits for cracks or breaks. Look for moisture collection.

3-9. Solvent Cleaning System. Items 9 and 10 of your (B) PMCS apply to the solvent cleaning system.

a. Solvent Tank. Operator maintenance of the solvent tank consists of inspection and servicing.

(1). Inspection. Check the solvent tank for leaks. Be sure to wipe it down thoroughly with a clean, lint-free rag. This will help you locate the source of any leaks which you may have found.

(2). Servicing.

WARNING

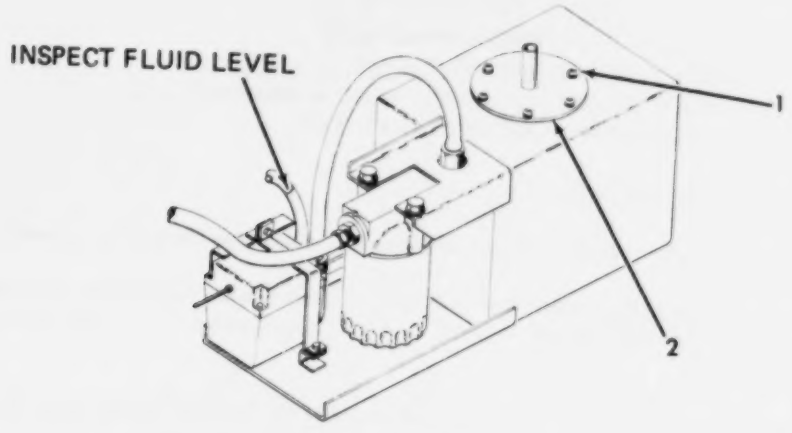
BE SURE THAT ALL ELECTRICAL POWER TO THE HSTRU IS OFF BEFORE SERVICING THE SOLVENT TANK.

BE SURE THAT THE HSTRU IS PROPERLY GROUNDED PRIOR TO SERVICING THE SOLVENT TANK.

NOTE

REVIEW YOUR (B) PMCS, ITEM 9. THE PROCEDURES DESCRIBED THERE APPLY TO SERVICING THE SOLVENT TANK.

Visually inspect the fluid level in plastic tube. The fluid level should be within 2 inches of the top of the tank. If it is not, service it with solvent.



(3). Cleaning. Once a year, clean the solvent tank. Remove the drain plug from the bottom of the tank and drain the tank.

NOTE

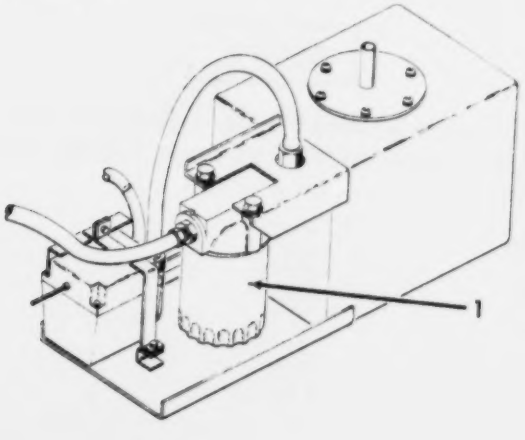
BE SURE TO PROPERLY DISPOSE OF CONTAMINATED SOLVENT.

Remove the screws (1) and lift the access plate (2) off. Clean the tank with solvent and lint-free rag.

b. Filter Assembly. Item 10 of your (B) PMCS applies to the filter assembly. The filter should be inspected during each use of the solvent cleaning system. Check the filter for leaks at its fittings. If there is a reduced output flow, change the filter. To change the filter, turn the pump off and unscrew the spinoff filter (1). Lower the spinoff filter from the filter assembly and replace.

NOTE

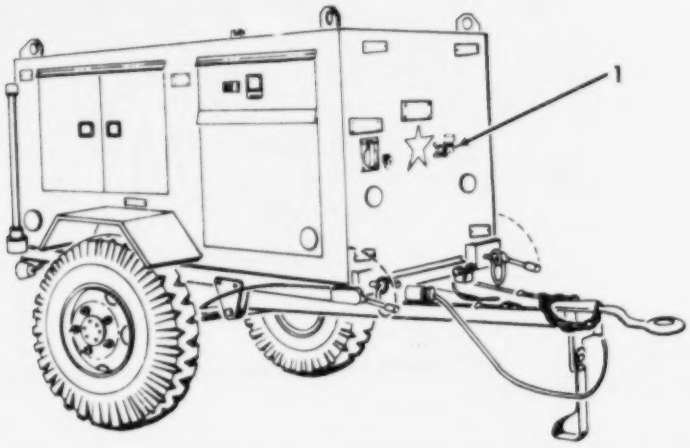
USE SUITABLE CONTAINER UNDER FILTER TO PREVENT SOLVENT SPILL.



c. *Hose and Nozzle*. Inspect the hose and nozzle for leaks, flow restriction and proper operation of the nozzle. Replace the hose and/or nozzle as necessary.

d. *Solvent Pump*. Inspect the solvent pump for proper installation, cracks in the pump housing, and leaks. Your (B) PMCS, item 7, applies to this.

e. *Breather*. Check the breather vent (1) prior to operation of the solvent wash unit. If the breather vent (1) looks clogged or dirty, replace it.



f. *Wash Tray*. Inspect the wash tray for leaks. Check the return line for leaks, ruptures, or loose fittings. Clean the screen which covers the tray drain hole.

3-10. Electrical Tools. Prior to using the hose coupling assembler, hose cutting saw, transfer pump, and impact wrench, inspect the cord for damaged insulation, check the plug for damaged prongs or loose connections, and check the power switch for evidence of arcing (black, charred residue). Be sure to check the large ground prong on the plug. Also check the following items.

a. *Hose Cutting Saw*. Inspect the blade for nicks, chips, cracks, (including hairline) or corrosion. Replace if necessary.

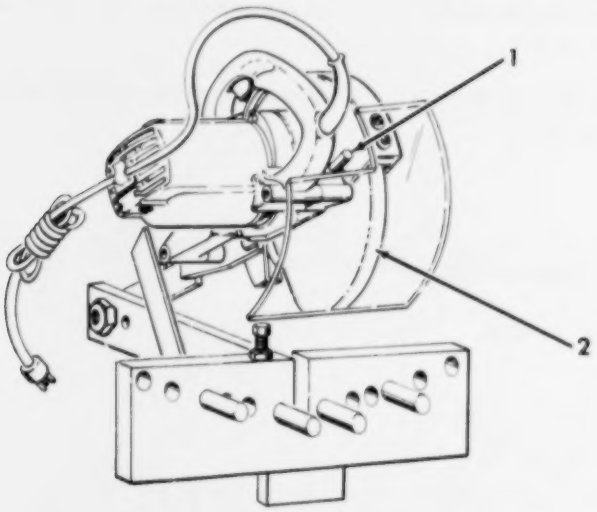
WARNING

DO NOT ATTEMPT TO SHARPEN THE SAW BLADE.

CAUTION

THE SAW BLADE STUD HAS A LEFT-HAND THREAD.
TIGHTEN IT BY TURNING IT COUNTERCLOCKWISE.

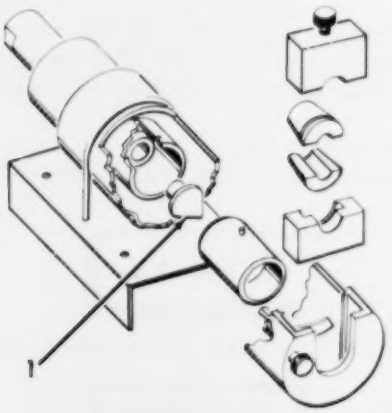
To remove the old blade, hold the shaft lock pin (1) in and loosen the threaded saw blade stud. Raise the guard (2) and remove the blade, stud and washer. Insert the stud and washer through the new blade and install it.



b. Transfer Pump Filter. Inspect the transfer pump filter indicator during operation. If the filter needs to be replaced, use the procedure in PMCS item 20.

3-11. Tube Flaring Tool. Several parts of the tube flaring tool require specific inspection and replacement. The following paragraphs describe those requirements.

a. Flaring Face. Inspect the flaring cone (1) for nicks, cracks, or scratches. If any severe mar or marks are found, replace the flaring cone.



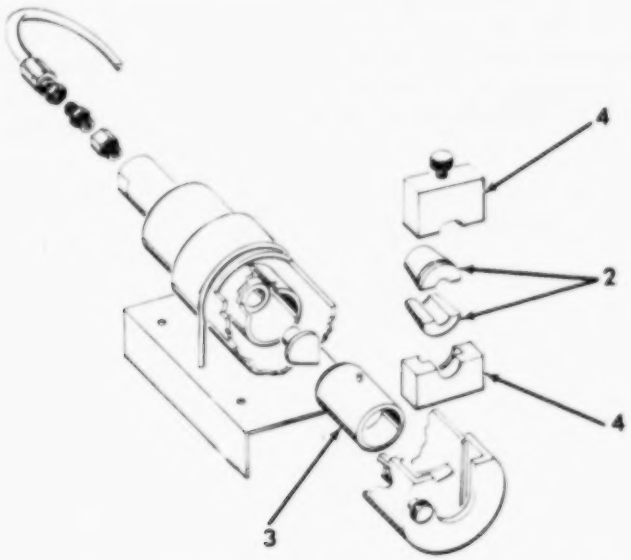
CAUTION

BE SURE THAT THE FLARING CONE, INNER SURFACES OF THE DIE RINGS, AND OUTER SURFACES OF THE DIE SETS ARE PROPERLY LUBRICATED BEFORE USING THE TOOL.

b. *Flaring Dies.* Inspect the inside of the flaring dies (2), for nicks and scratches. Inspect the flaring dies for evidence of cracks. Replace the dies as necessary.

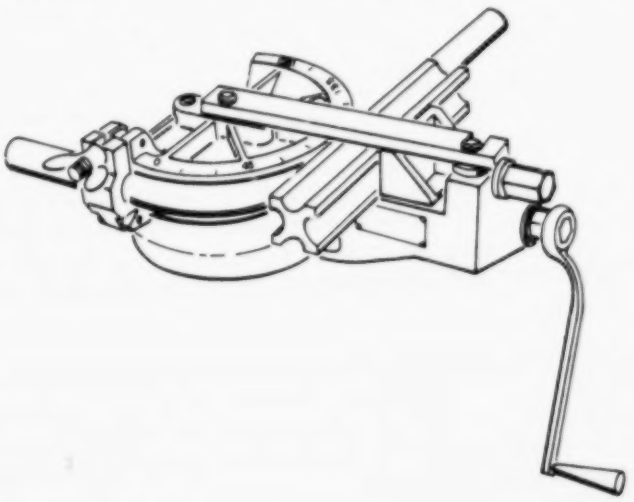
c. *Die Rings.* Inspect the die ring (3) for nicks, scratches, and cracks. Replace the ring as necessary.

d. *Die Retainer Assembly.* Inspect the die retainer (4) and replace assembly as necessary.



3-12. Servicing Hand Tools. Several of your hand tools require periodic servicing. You should lightly oil slip-joint pliers and crescent wrenches.

a. *Tube Bender.* All parts of the tube bender should be kept clean and free from dirt and grit. The slide blocks and radius blocks should be handled carefully to avoid damaging the smooth ground surfaces. This should be done because the presence of nicks, burns, pieces of dirt, or chips may mar the surface of the tube and weaken it or cause leak paths. All threaded parts should be cleaned and lightly greased to keep them in good working condition.

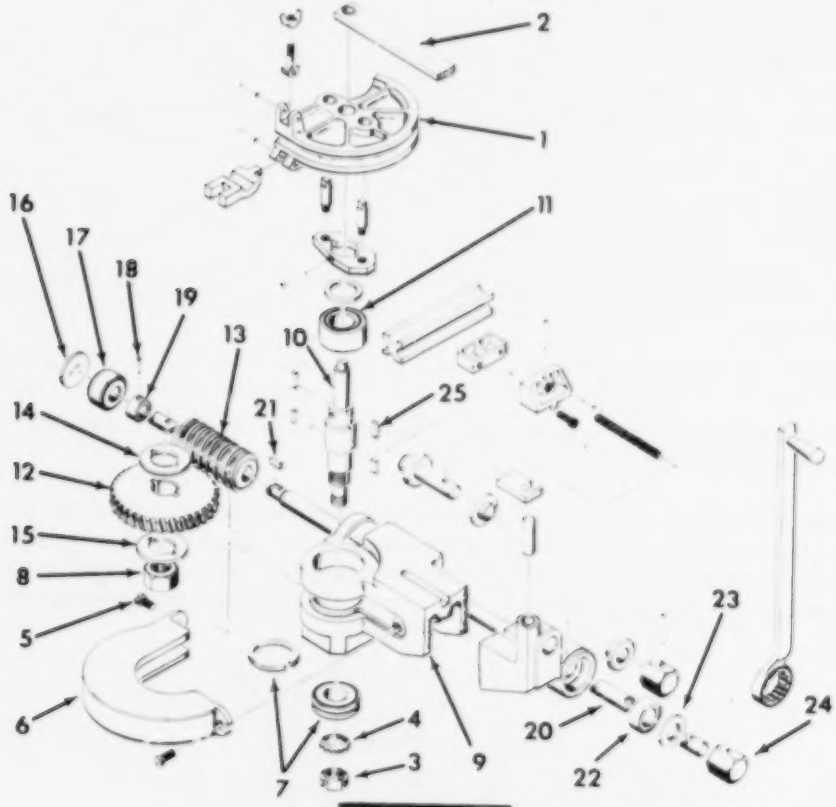


(1). Gear Removal. To remove and replace the gears in the tube bender if it becomes necessary to do so, use the following procedures.

WARNING

USE PROPER LIFTING TECHNIQUES WHEN PICKING UP THE TUBE BENDER.

Remove the radius block (1) and tie bar (2) if installed. Remove the lock nut (3) and lock washer (4). Remove the two 1/4-28 machine screws (5) and the gear guard (6). Remove both bearing and snap ring (7) together (it is not necessary to remove snap ring from bearing). Remove nut (8). Tap the shaft assembly (10) out of the body (9).



NOTE

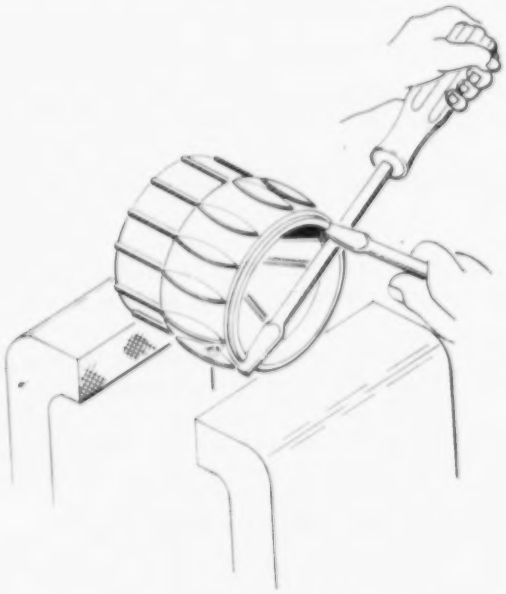
YOU WILL NEED TO REMOVE THE FOUR KEYS (25) IN ORDER TO GET THE SHAFT ASSEMBLY OUT OF THE BODY.

This will permit the worm gear (12) to be disengaged from the worm (13) and removed with the two large washers (14) (15). Visually inspect the worm (13) and determine if it needs to be replaced. If the worm (13) needs to be replaced, drive pin out of hex cap (24), remove cap and flat washer, and tap the assembly out of the body. Remove the single row ball bearing (17). Remove the pin (18) from the collar (19) and shaft (20). Remove the key (21) from the shaft (20) and slide the worm (13) off of the shaft.

(2). Gear Replacement. Thoroughly lubricate the new worm (13) with LSA oil. Slide the worm (13) on to the shaft (20). Line up the keyways and insert the key (21). Slide the collar (19) onto the shaft (20) and insert the pin (18) through the collar into the shaft. Lubricate bearing (17) and place into the shaft. Lubricate the other bearing (22) and gently tap it into the body. Insert the shaft, with the worm and bearing on it, into the body. Tap dust cover (16) into place. Next install washer (23) and hex-head cap (24). Tap the roll pin into the hex-head cap. To replace the worm gear (12), slide the worm gear into the housing. Insert the shaft assembly with the keys and one notched washer and the bearing (11) prepositioned on it, into the body and tap into place. Install second notched washer (15) and nut (8). Tighten lightly. Tap bearing and snap ring (7) into place (groove on bearing faces outward). Install lockwasher (4) and nut (3). Tighten nut snug and back off 1/4 turn. Bend a tab of the lockwasher into the corresponding notch on the nut. Replace the gear guard (6) and machine screws (5).

b. *Hose Skiving Tool.* Inspect the hose skiving tool for serviceability. If it is not serviceable, replace it. Sharpen or replace blade if nicked or dull.

c. *Deburring Tool.* Inspect the deburring tool for serviceability. If it is not serviceable, replace it. Sharpen or replace blade if nicked or dull. If a spanner wrench is not available, the tool may be disassembled in the vise as shown.



d. *Machinists Vise.* Inspect the machinists vise. Lubricate it in accordance with the lubrication instructions in Chapter 3, Section II. If it requires replacement, see paragraph 4-11.

e. *Crosscut Vise.* Inspect the crosscut vise for serviceability. Lubricate it in accordance with the lubrication instructions in Chapter 3, Section II. If the vise is unserviceable, replace it.

f. *Ferrule Setting Tool.* Inspect the ferrule setting tool for serviceability. If the ferrule seating surface is damaged, replace it.

g. *Hose Perforator.* Inspect hose perforator tool. If damaged, replace it.

3-13. Cleaning.

CAUTION

REMOVE ALL TOOLS INCLUDING THE POWER SAW AND HOSE COUPLING MACHINE BEFORE WASHING OR STEAM CLEANING.

The HSTRU should be washed with clear water and a mild detergent whenever required. The unit can be steam cleaned. Spot cleaning should be accomplished as necessary.

NOTE

BE SURE TO REMOVE THE DRAIN PLUGS FROM THE HSTRU, AND ALLOW THE WATER TO DRAIN OUT. ALLOW THE UNIT TO DRY COMPLETELY BEFORE REPLACING TOOLS AND PLUGS.

WHEN WASHING, BE SURE TO CLEAN BOTH THE INTERIOR AND THE EXTERIOR OF THE HSTRU.

3-14. Accessory Maintenance. A number of accessory items are installed and/or included in the HSTRU. These items should be inspected periodically.

a. Equipment Troubleshooting Adapter Kit. Check the kit to be sure that it includes the items that it should have. Check threads of individual adapters and replace adapters that have damaged threads.

b. System Flushing Unit. Inspect the system flushing unit to ensure that the filters are in good condition. Replace elements as required. Replace the filter assembly if the housing is cracked.

c. Drop Light. Inspect the drop light to see that the cord is not frayed, worn, or broken. Check to see that the light can be rolled up on the reel. Turn the light on and see that it works. Replace the bulb as necessary.

d. O-ring Kit. Inspect the O-ring kit to see that a minimum of O-rings of each size are included. Replace O-rings as necessary.

e. O-ring Fabrication Kit. Replace adhesive, cord stock, solvent and water proofing solution as necessary. Note expiration date of adhesive. Replace if expired.

f. Plumbing Fabrication Components. Check to see that you have enough hose, couplings, tubing, and fittings.

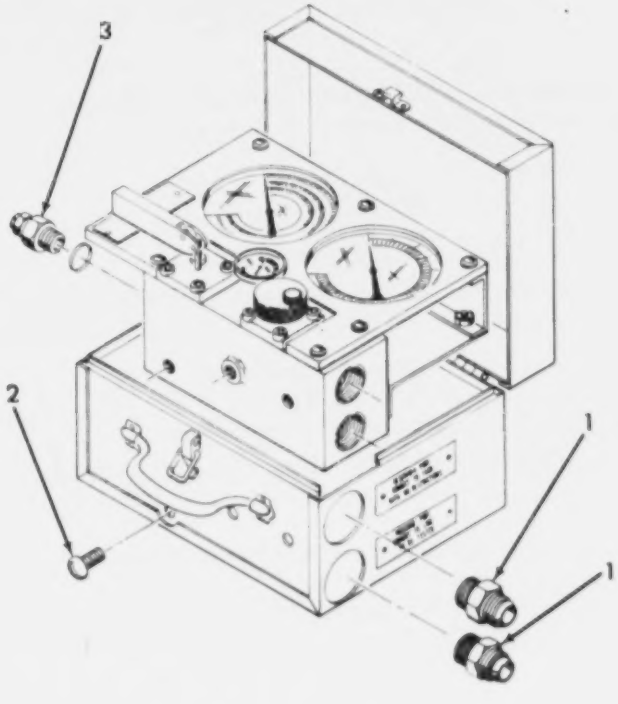
3-15. Test Equipment. The items of test equipment included in the HSTRU need to be inspected from time to time.

a. Proof Pressure System. Inspect the hand pump for leaks. Look for cracks on the handle. Make sure the by-pass valve works (see item 11, PMCS, callout 1). Check the pressure gage for any evidence of damage. Look for dents on the case, broken glass, and broken or binding needle. If replacement is necessary, contact general support maintenance. Service with HDO-10 (MIL-L-2104) as necessary.

b. Multi-Range Pressure Gage. Inspect the multi-range pressure gage for evidence of damage. Look for dents or cracks in the case, broken plexiglass, and broken or binding needles. Be sure that the gage pointers (needles) are positioned at zero ("0") when the gage is not in operation. For calibration or repair, turn in to general support maintenance. If beyond repair, replace it.

c. Hydraulic System Tester. Inspect the hydraulic system tester for evidence of damage. Look for dents or cracks on the case, broken or cracked glass on the indicators, and broken or binding indicator needles. Be sure that the indicator needles are positioned at ("0") when the gage is not in operation. Inspect the case for evidence of hydraulic oil leakage inside the case (leakage at seams, cover, etc.). Leakage of this sort may indicate a ruptured blowout plug. To inspect or replace the blowout plug, use the following procedures:

1. Shut down system (if operating).
2. Remove connections.
3. Remove tester inlet and outlet fittings (1).
4. Drain oil from case.
5. Remove the three large screws (2) from the handle side of the tester case.
6. Carefully remove the tester from the case and clean it thoroughly.
7. Locate the brass blowout plug (3) and remove it.
8. Insert new blowout plug.
9. Reassemble tester.



CHAPTER 4

DIRECT SUPPORT AND GENERAL SUPPORT MAINTENANCE

SECTION I

DIRECT SUPPORT MAINTENANCE

4-1. General. This section describes HSTRU maintenance which will take place at the direct support level of maintenance.

4-2. Troubleshooting. Troubleshooting procedures for direct support and general support maintenance of the HSTRU are found in Section III of Chapter 3.

4-3. Repair Parts, Special Tools and Equipment. See paragraphs 3-1 and 3-2 for information regarding repair parts, special tools, and equipment requirements for the HSTRU.

4-4. HSTRU Body. HSTRU body maintenance performed at the direct support maintenance level is limited to replacement of door assemblies and fenders, and repair of shelving. The following paragraphs describe removal and replacement procedures for those items.

a. *Doors.* Replacement of enclosure doors may be accomplished at the direct support level.

WARNING

BE SURE TO KEEP YOUR HANDS OUT OF HINGE AND SUPPORT BRACKET JOINTS DURING DOOR REMOVAL AND OPERATION.

(1). Forward Right Hand Upper Door. To remove the forward right hand upper door, grasp the latch handle and pull it toward you. This will unlatch the upper door. Allow the upper door to hang on its hinge; however, do not permit it to close.

WARNING

WHEN YOU REMOVE THE HINGE PIN FROM THE HINGE, BE CAREFUL NOT TO LET THE DOOR FALL ON YOU.

CAUTION

BE SURE TO PULL THE HINGE PIN STRAIGHT OUT OF THE HINGE TO AVOID BENDING THE PIN.

Remove the hinge pin. If it is bent, warped, or excessively scarred or scratched, install a new hinge pin when you install the new door.

NOTE

IT MAY BE NECESSARY TO LOOSEN THE HINGE PIN BY GENTLY TAPPING A PUNCH PLACED AGAINST THE END OF THE HINGE PIN WITH A HAMMER.

YOU WILL HAVE TO HOLD THE DOOR IN POSITION TO PREVENT THE HINGE PIN FROM BENDING AS YOU REMOVE IT.

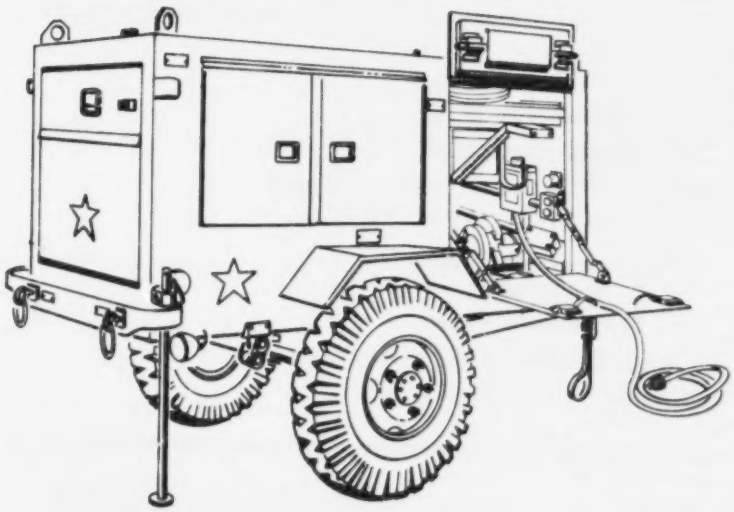
Remove the door and set it aside. Hold the new door in place. Slide the hinge pin into the hinge.

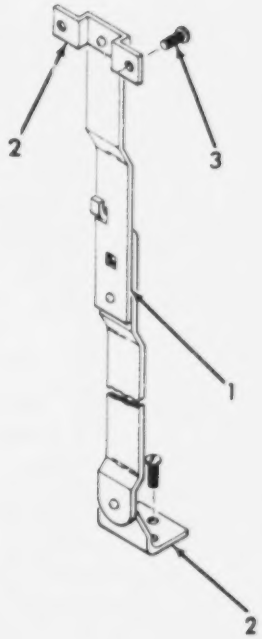
CAUTION

BE SURE THE NEW DOOR FITS PROPERLY BEFORE YOU TRY TO LATCH IT. SWING IT TO THE UP POSITION AND SEE THAT IT CONTACTS THE UPLOCK IN THE PROPER FASHION. DO NOT ATTEMPT TO FORCE THE DOOR.

Close the upper door and allow it to latch. Shim and adjust as required.

(2). Forward Right Hand Lower Door. To replace the forward right hand lower door, unlatch the forward right hand upper door and push it to the up position. Pin it in place. Reach inside the compartment and grasp the lower door handles. Pull up on the lower door handles until the lower door unlatches. Open the door to the down position. You will notice that the door brace arms (1) are riveted to brackets (2) which are attached to the door with screws (3). Remove the screws (3) from the door end of the brackets (2). Permit the door to hang on its hinge. Put the screws in a screw bag and secure the bag to one of the brace arms (1).





WARNING

BE CAREFUL NOT TO LET THE DOOR FALL ON YOU WHEN YOU REMOVE BRACE ARMS OR THE HINGE PIN.

Remove the hinge pin from the door hinge. If it is bent, warped, or excessively scarred or scratched, install a new hinge pin when you install the new door.

NOTE

IT MAY BE NECESSARY TO LOOSEN THE HINGE PIN BY GENTLY TAPPING A PUNCH PLACED AGAINST THE END OF THE HINGE PIN WITH A HAMMER.

YOU WILL HAVE TO HOLD THE DOOR IN POSITION AND NOT LET IT SAG TO KEEP THE HINGE FROM BINDING AS YOU REMOVE IT.

Remove the door and set it aside. Hold the new door in place. Slide the hinge pin into the hinge. Allow the new door to hang on its hinge. Remove the screw bag from the brace arm and remove the screws from it. Raise the door up sufficiently to allow the brace arms brackets (1) to line up with mounting holes in the door. Attach the brace arm brackets to the door with screws dipped in thread adhesive.

CAUTION

BE SURE THE NEW DOOR FITS PROPERLY. SWING IT UP AND NOTICE WHETHER OR NOT THE DOOR LATCHES POSITION PROPERLY AS THE DOOR IS CLOSED. DO NOT ATTEMPT TO FORCE THE DOOR.

Close the lower door and allow it to latch. Close the upper door and dispose of the old door and hinge pin. Shim and adjust as required.

(3). Aft Upper Door. Use the procedures in paragraphs 4-4a(1) for removal and replacement of the aft upper door.

(4). Aft Lower Door. Use the procedures in paragraph 4-4a(2) to remove and replace the aft lower door. Before removing the aft lower door, remove the vise.

WARNING

BE CAREFUL NOT TO HURT YOURSELF WHEN REMOVING THE VISE. IT IS HEAVY. USE PROPER LIFTING TECHNIQUES.

(5). Vertically Hinged Doors. All of the vertically hinged doors on the HSTRU are removed and replaced in the same fashion except the forward left hand doors. Paragraph 4-4a(6) will describe how to remove and replace the

forward left hand door. To remove any of the vertically hinged doors except the left hand forward door, all you have to do is open the door and remove the hinge pin from the hinge.

WARNING

WHEN YOU REMOVE THE HINGE PIN FROM THE HINGE, BE CAREFUL NOT TO LET THE DOOR FALL ON YOU.

CAUTION

BE SURE TO PULL THE HINGE PIN STRAIGHT OUT OF THE HINGE TO AVOID BENDING THE PIN.

TO REMOVE THE HINGE PIN, YOU WILL HAVE TO HOLD THE DOOR IN POSITION TO PREVENT THE HINGE PIN FROM BINDING WHEN YOU REMOVE IT.

NOTE

IT MAY BE NECESSARY TO LOOSEN THE HINGE PIN BY GENTLY TAPPING A PUNCH PLACED AGAINST THE END OF THE HINGE PIN WITH A HAMMER.

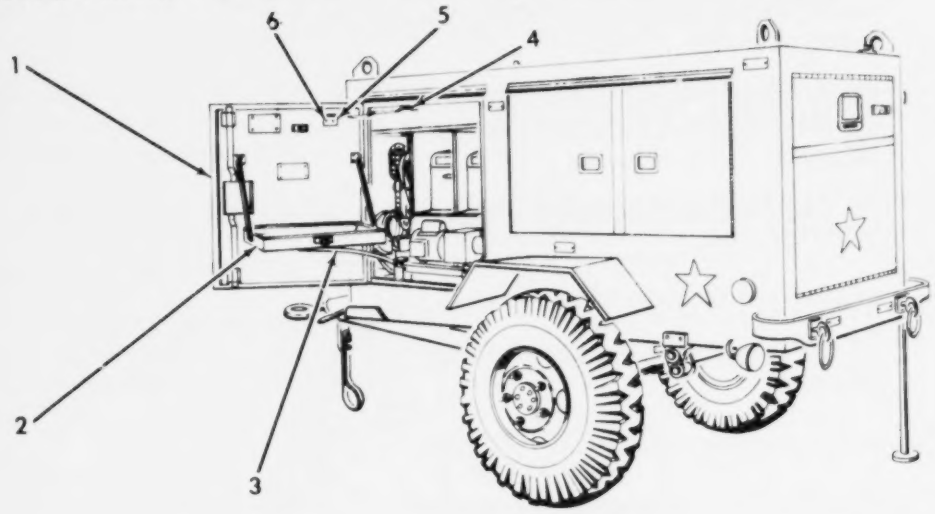
Remove the door and set it aside. Hold the new door in place. Slide the hinge pin into the hinge. Remove data plates from old door and install on new doors.

CAUTION

BE SURE THAT THE NEW DOOR FITS PROPERLY. SWING IT TO BE SURE THAT THE LATCHES CONTACT EACH OTHER PROPERLY AS THE DOOR IS CLOSED. DO NOT ATTEMPT TO FORCE THE DOOR.

Close the new door and latch it. Shim and adjust as required.

(6). Forward Left Hand Door. To remove and replace the forward left hand door (1) on the HSTRU open it and disconnect the drain line (3) from the wash tray (2): stow the drainline in the enclosure. Remove the screws (6) from the bracket (5) which the brace arm (4) is attached to. Put the screws in a screw bag and tie the screw bag to the brace arm. Remove wash tray and remount on new door. Remove the hinge pin.



WARNING

BE CAREFUL NOT TO LET THE DOOR FALL ON YOU WHEN YOU REMOVE THE HINGE PIN.

CAUTION

PLUG END OF LINE TO PREVENT SOLVENT TANK DRAINAGE.

NOTE

TO REMOVE THE HINGE PIN, YOU WILL HAVE TO HOLD THE DOOR IN PLACE TO PREVENT THE HINGE PIN FROM BENDING AS YOU PULL IT OUT.

Remove the door and set it aside. Hold the new door in place. Put the hinge pin into the hinge. Remove the screw bag from the brace arm. Line the bracket up with the holes in the new door and install the screws which were in the screw bag.

(7). Work Surfaces. The work surfaces may need to be removed from the forward right hand lower door and the rear lower door. To do this, first remove all the door hardware and/or tools which are in the way of removing the work surface. Remove the fasteners which hold the work surface in place and slide the work surface off of the door.

b. Fenders. The fenders on the HSTRU are bolted to the enclosure body. They should not require any maintenance, other than replacement. Small skin cracks which do not require fender replacement can be welded with the fender on the trailer.

WARNING

BE SURE TO KEEP FLAME AND HEAT AWAY FROM FLAMMABLE AND/OR EXPLOSIVE COMPONENTS OR SUPPLIES WHILE WELDING.

USE APPROVED HELMETS, GOGGLES, GLOVES, AND OTHER PROTECTIVE EQUIPMENT AS REQUIRED WHEN WELDING.

BE SURE THAT VENTILATION IS ADEQUATE BEFORE YOU START WELDING.

BE SURE A FIRE EXTINGUISHER IS AVAILABLE.

DO NOT WELD IF YOU SEE ANY EVIDENCE OF A HYDRAULIC LEAK.

If the fender needs to be replaced, a new one should be bolted in place.

c. Shelving. The shelving in the HSTRU may, from time to time, need to be repaired. Most of these repairs will be necessary because of cracks in the metal shelving. In most cases, these cracks can be welded on the trailer.

WARNING

BE SURE TO KEEP FLAME & HEAT AWAY FROM FLAMMABLE AND/OR EXPLOSIVE COMPONENTS OR SUPPLIES WHILE WELDING.

WEAR APPROVED HELMETS, GOGGLES, GLOVES AND OTHER PROTECTIVE EQUIPMENT, AS REQUIRED WHEN WELDING.

BE SURE THAT VENTILATION IS ADEQUATE BEFORE YOU START WELDING.

d. Sliding Rack. The sliding rack is mounted on six rollers. To replace the forward rollers, pull the rack out, then unscrew and replace the rollers. To replace the middle and rear rollers, the rack must be removed. Pull the rack out and remove the forward rollers. Then push the rack in and tip it up so that it will clear the rear rollers, and pull the rack from the trailer. Unscrew and replace the rollers. Re-install the rack in the same manner as it was removed.

4-5. Electrical Distribution System.

a. Circuit Breaker. From time to time, you may be called upon to test and/or replace the circuit breaker. Some common reasons for this are electrical system troubleshooting, installation of a new circuit breaker box, or installation of a new circuit breaker. The following procedure describes how to replace the circuit breaker. If the circuit breaker proves to be faulty and needs to be replaced, remove external power from the HSTRU.

WARNING

DO NOT ATTEMPT TO CHANGE THE CIRCUIT BREAKER WITH ELECTRICAL POWER ON THE UNIT.

Remove the large screw from the front panel of the circuit breaker box. Take the panel off and snap out the faulty breaker. Install a new circuit breaker and replace the front panel. Check the new circuit breaker by using the procedures in paragraph 3-8b.

b. Electrical Connectors. If it is necessary to replace a connector or terminal lug, remove the nut and washer and clip off the old lug. Then trim back the insulation and crimp on a new lug using a pair of crimps. Be sure you get a good metal to metal contact, then re-connect the lug to the terminal.

c. Electrical Outlets and Switches. You may discover, in troubleshooting in the electrical system, that you will be called upon to test or replace an electrical outlet or switch. The following procedures describe how to check out and replace those components.

(1). Testing Electrical Outlets.

WARNING

BE SURE THE HSTRU IS PROPERLY GROUNDED BEFORE APPLYING ELECTRICAL POWER.

BE SURE THE FIRE EXTINGUISHER IS READY FOR USE PRIOR TO APPLYING ELECTRICAL POWER.

Apply electrical power to the HSTRU and place the circuit breaker in the "on" position. Once the circuit breaker is in the "on" position, use an outlet tester or electrical tool to see if you have power to the outlet. If there is no power to the outlet, troubleshoot the electrical system.

(2). Replacing Electrical Outlets. If the outlet proves to be faulty and needs to be replaced, remove external power from the HSTRU.

WARNING

DO NOT ATTEMPT TO CHANGE AN ELECTRICAL OUTLET WITH ELECTRICAL POWER STILL ON THE UNIT.

If the electrical outlet needs to be replaced, turn the electrical power off and disconnect it from the unit. Remove the outlet face plate from the outlet which you wish to change. Remove the screws which hold the plugs into the outlet housing and pull the plugs out of the housing. Disconnect the wires from the back of the plug.

NOTE

BE SURE TO NOTICE THE ORDER IN WHICH THE ELECTRICAL WIRES WERE ATTACHED. ATTACH THEM TO THE NEW PLUG IN THE SAME FASHION.

Connect the new plug. Test the new plug by using the procedures in paragraph 3-8d.

(3). Testing Electrical Switches.

WARNING

BE SURE THE HSTRU IS PROPERLY GROUNDED BEFORE APPLYING ELECTRICAL POWER.

BE SURE THE FIRE EXTINGUISHER IS READY FOR USE PRIOR TO APPLYING ELECTRICAL POWER.

Apply electrical power to the HSTRU and place the circuit breaker in the "on" position. Plug an outlet tester or electrical tool into the outlet controlled by the switch you want to test. Place the switch in the "on" position to see that there is power to the outlet. If there is no power to the outlet, troubleshoot the system in accordance with the provisions of Section III, Chapter 3 of this manual.

(4). Replacing Electrical Switches. The procedure for replacing switches is the same as the procedure for replacing outlets.

d. Testing Electrical Lines.

WARNING

BE SURE THE HSTRU IS PROPERLY GROUNDED BEFORE APPLYING ELECTRICAL POWER.

BE SURE THE FIRE EXTINGUISHER IS READY FOR USE PRIOR TO APPLYING ELECTRICAL POWER.

NOTE

TESTING ELECTRIC LINES IS A STEP COMMONLY ASSOCIATED WITH ELECTRICAL SYSTEM TROUBLESHOOTING.

In order to test electrical lines, you must first make sure that the components on either end of the line which you want to test are working. Whenever you want to test an electrical line, use the following procedure.

(1). Make sure that electrical power is correctly connected to the HSTRU.

(2). Make sure that the tool or other item which you plan to use to test the circuit is operating correctly.

(3). Turn the circuit breaker off and disassemble the outlet to make sure that there is no visible reason why the outlet would not work. Reassemble the outlet.

(4). Turn the circuit breaker back to the "on" position, plug in the tool, and test to see if it will operate. If it will not, replace the electrical lines to that outlet.

4-6. Solvent Tank.

WARNING

BE SURE THAT POWER TO SWITCH S 1 AND PLUG J-4 (SEE FIGURE 3-2) HAS BEEN REMOVED PRIOR TO PERFORMING ANY MAINTENANCE ON THE SOLVENT SYSTEM.

a. Remove. Turn solvent pump on and pump solvent into a 5 gallon container. Turn off and unplug the pump. Go under the trailer and remove the plug from the bottom of the tank and drain the remaining solvent. While under the trailer, remove the four bolts with lock washers and nuts which hold the tank assembly to the HSTRU, and remove the large nut from the drain plug fixture. Disconnect the wash hose from the filter, the drain line from the wash tray and the breather line from the tank. Lift the tank assembly out of the HSTRU. Disconnect the pump suction line at the tank and the pump output line at the filter. Remove the filter by unscrewing the two mounting bolts with lock washers. Remove two screws, nuts and lock washers from the pump holding strap, and remove the pump assembly.

b. Reinstall. Attach the pump assembly to the new tank with the strap and two screws, lock washers and nuts. Attach the filter to the new tank with two bolts and lock washers.

NOTE

MAKE SURE THE FILTER IS POSITIONED PROPERLY SO THAT THE TUBE FROM THE WASH PUMP CONNECTS TO THE FILTER INLET.

Reconnect the pump suction line to the tank and the pump output line to the filter. Position the tank assembly in the HSTRU and secure it in place with the four bolts with lock washers and nuts, and the large nut which holds the drain plug fixture.

NOTE

DO NOT TIGHTEN THE BOLTS OR SCREWS UNTIL ALL BOLTS AND SCREWS HAVE BEEN STARTED.

Apply sealant to the drain plug and insert and tighten drain plug into tank drain port. Connect the breather line to the tank, the drain line to the wash tray, and the wash hose to the filter. Fill the solvent tank by using the procedure listed in PMCS 9.

4-7. Solvent Wash Pump. If the solvent wash pump needs to be replaced, remove and cap all lines leading to and from it. Remove the bolts which hold the pump strap in place. Remove the pump strap and lift the pump out. To install a new pump, set it in place and position the pump strap over it. Insert and tighten the bolts which hold the strap. Uncap and connect all lines. Plug in the pump.

4-8. Solvent Cleaning Tray. To remove the solvent cleaning tray, disconnect and plug the drain line. Remove the bolts which connect the brace arm brackets to the lower ends of the arms.

WARNING

HOLD ON TO THE SOLVENT CLEANING TRAY, AS YOU REMOVE THE SCREWS FROM THE HINGES, TO PREVENT THE TRAY FROM FALLING.

Remove the screws from the hinges and take the cleaning tray off the door. To install a new wash tray, line the hinges up and insert the mounting screws. Line up the brace arms and insert the connecting bolts. Unplug and connect the drain line.

4-9. Electrical Tools. Replacement and repair of power tools in the HSTRU is accomplished at the direct support maintenance level. The following paragraphs describe those repairs.

a. Brushes. Periodically, the brushes on the hose cutting saw and the hose coupling assembler will have to be replaced. The following paragraphs describe how to do these things.

(1). Hose Coupling Assembler. Check the lower, most accessible brush assembly first, and if it is worn shorter than 1/2 inch, replace both brushes.

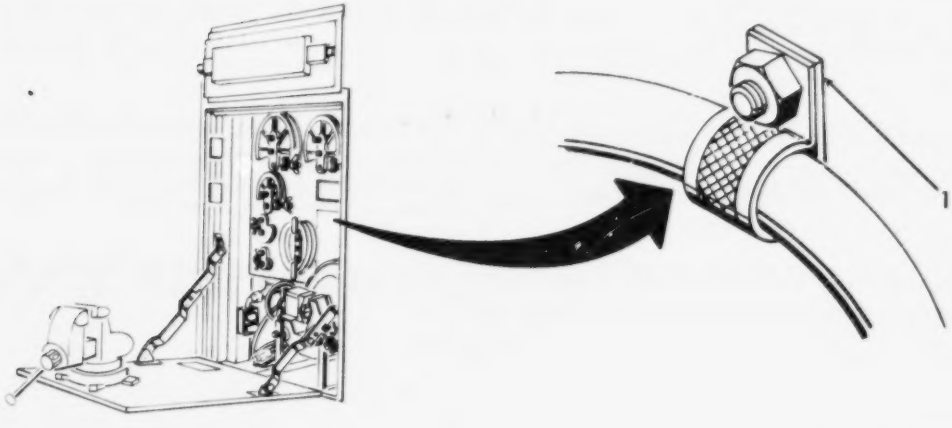
NOTE

IF THE COMMUTATOR IS WORN OR SCARRED, IT MUST BE TURNED DOWN AND THE MICA WILL HAVE TO BE UNDERCUT. THIS WILL REQUIRE THE SERVICES OF AN ELECTRICIAN.

To remove the lower brush assembly, the assembler must be removed from its sliding rack. Disconnect power. Unfasten power wire clamp (1) from wall behind machine and unwind power cord from cord stowage bracket. Slide out to operating position (PMCS 14).

WARNING

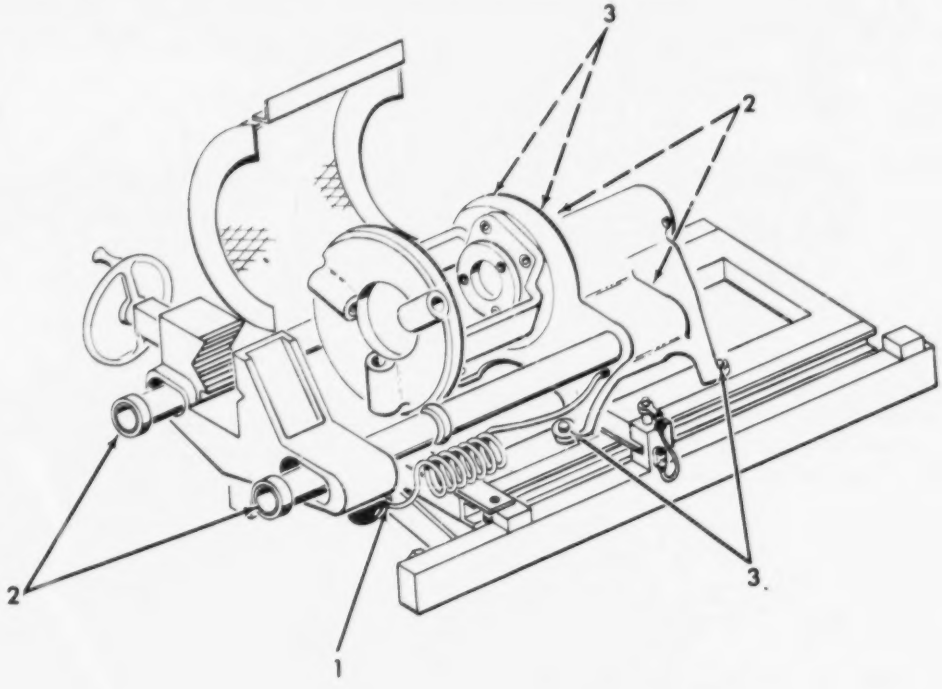
THE HOSE COUPLING ASSEMBLER IS VERY HEAVY. GET SOMEONE TO HELP YOU LIFT IT.

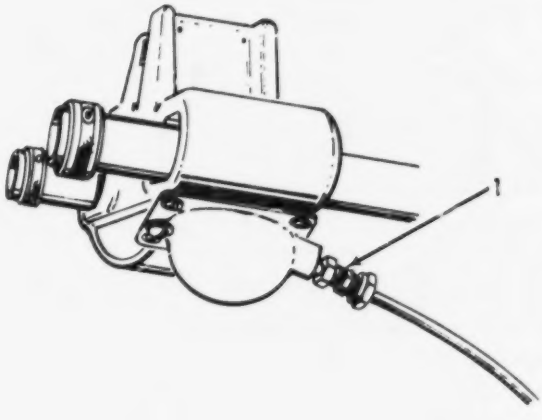


NOTE

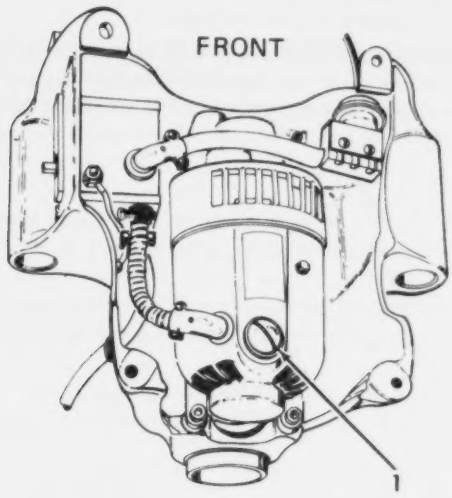
THE TOOL WILL BE EASIER TO MOVE ABOUT IF THE GUARD AND VISE ARE REMOVED.

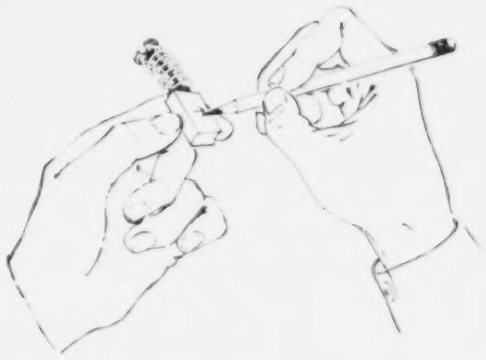
Disconnect the hand switch air hose connection (1). Loosen all four collars (2) on the guide rods and pull the vise sharply toward you. (Two of the collars are easily removed, the other two are not, due to the shape of the guide rods). Then remove the guide rods, vise and guard. Remove the four bolts (3) which secure the tool to the sliding rack.



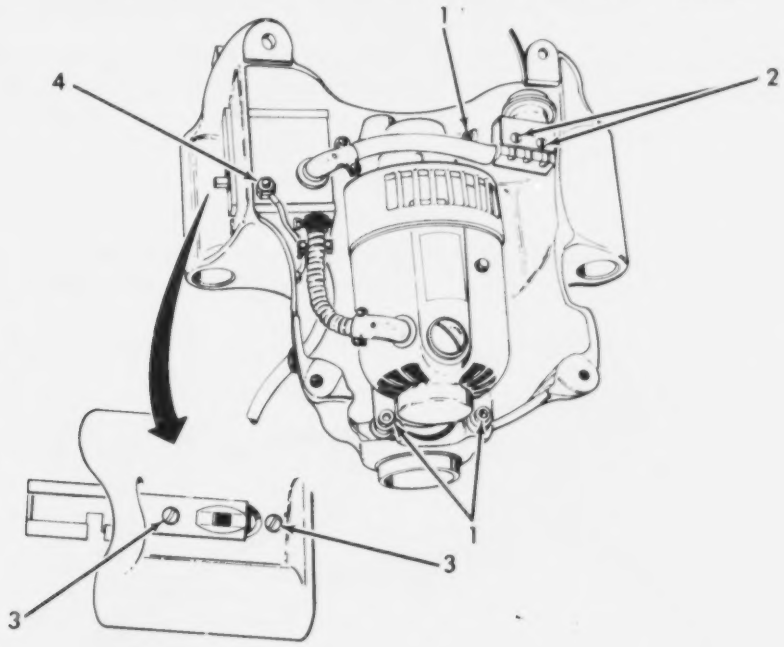


Pull the tool onto the work surface and turn it around. Remove the lower brush cap (1) and slide the brush assembly out. With a pencil, mark an arrow on the brush pointing toward the front of the motor, then measure the length of the black carbon brush.



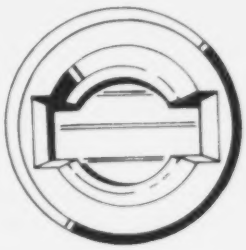


If it is longer than 1/2 inch, put it back in with the arrow pointing to the front, bolt the tool back in place on the sliding rack, restow the tool and reinstall the power wire clamp. Replace the guard, vise, and guide rods if they were removed. If the brush is shorter than 1/2 inch, the brushes must be replaced. The motor must be removed to replace the upper brush. To remove the motor, remove the three hex cap screws (1) which hold it in place.

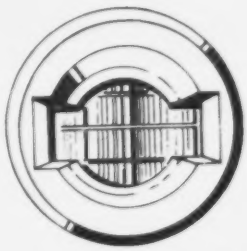


Remove the two screws (2) which hold the micro-switch to the air diaphragm. Remove the two screws (3) which hold the selector switch to the machine body. Disconnect the ground wire (4). Pry the motor out of the machine body. Remove the upper brush cap and brush assembly.

Rotate the motor and inspect the commutator for burnt spots or scoring.



Commutator OK



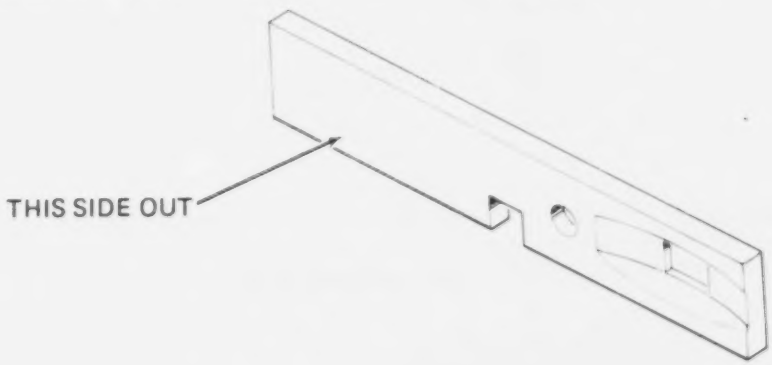
Commutator BAD

If it is damaged in anyway the motor must be replaced or repaired by an electrician. If the commutator is not damaged, install a new set of brushes.

CAUTION

BE SURE GEAR TEETH ON MOTOR MESH WITH RING GEAR TEETH WHEN ASSEMBLING.

Reinstall the motor in the machine body. Reconnect the ground wire. Reinstall the micro-switch and the selector switch. Be sure the safety interlock bar is in place with tapered edges facing out.



Place sliding vise close to machine body and reconnect air line. Plug in power cord and put reversing switch in an on position.

WARNING

MAKE SURE MOVING PARTS WILL NOT STRIKE ANYTHING OR ANYBODY. HOLD THE MACHINE BODY TO PREVENT ITS TURNING WHEN POWER IS APPLIED.

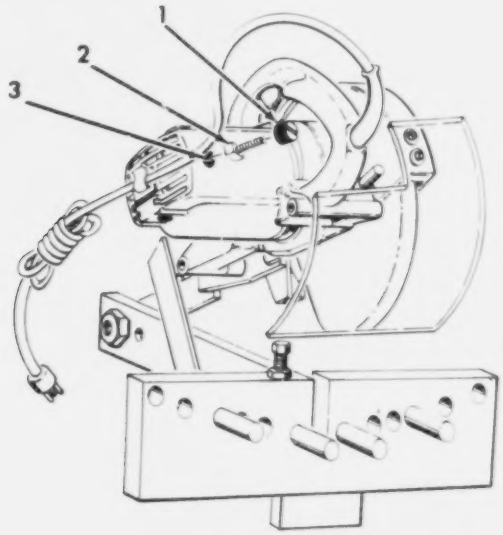
Press hand switch and run for a minute to be sure brushes are O.K. (It takes a minute or two for new brushes to seat properly). Unplug power cord.

CAUTION

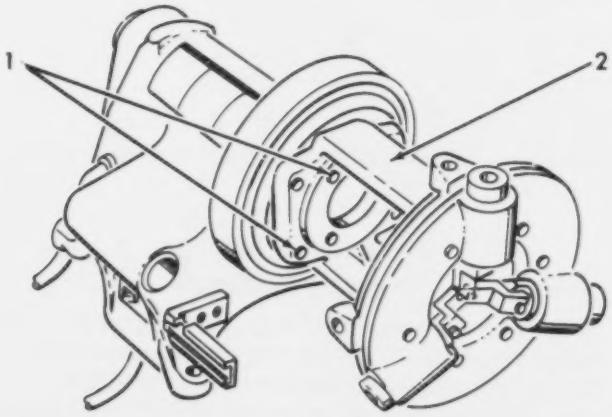
DO NOT ALLOW THE HAND SWITCH AIR HOSE TO BE DAMAGED IN THE NEXT STEP.

Push the tool back into place on the sliding rack and bolt it in place with the four mounting bolts. Reinstall the guard, vise, and guide rods. Tighten the collars in place.

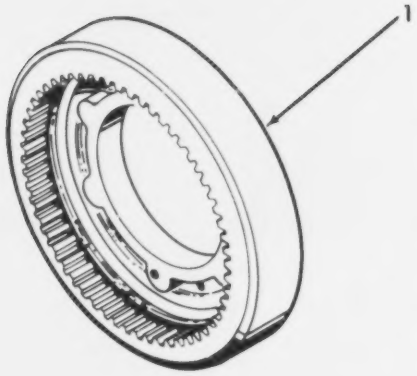
(2). Hose Cutter Assembly. To remove the brushes from the hose cutting saw, remove the brush cap (1) and take the brushes (2) out of the brush holder (3). To install new brushes (2), slide them into place in the holder (3) and install the brush cap (1).



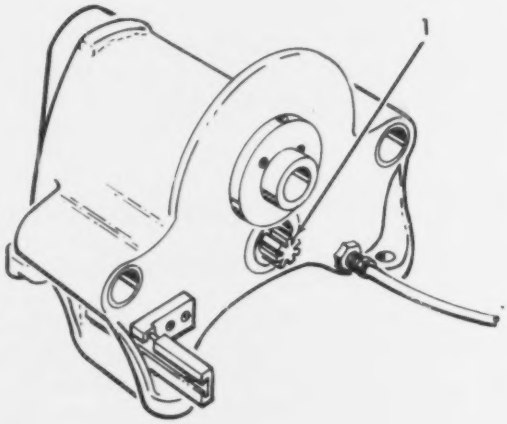
b. <u>*Hose Coupling Assembler Gears*</u>. If the hose coupling assembler hesitates and makes a clunk at the same point in each revolution of the chuck, the ring gear probably has a broken tooth. To change it, the assembler must be removed from its sliding rack. Follow the procedures in para. 4-9a(1), removing the vise, guard, and support bars also.



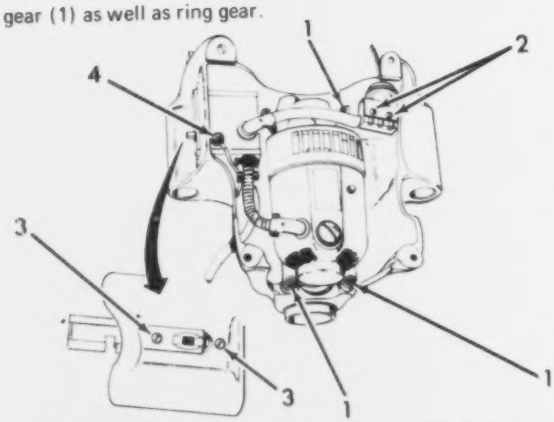
Remove seven screws (1) from ring gear and chuck assembly. Remove ring gear and chuck assembly (2) from shaft by tapping with rubber mallet.



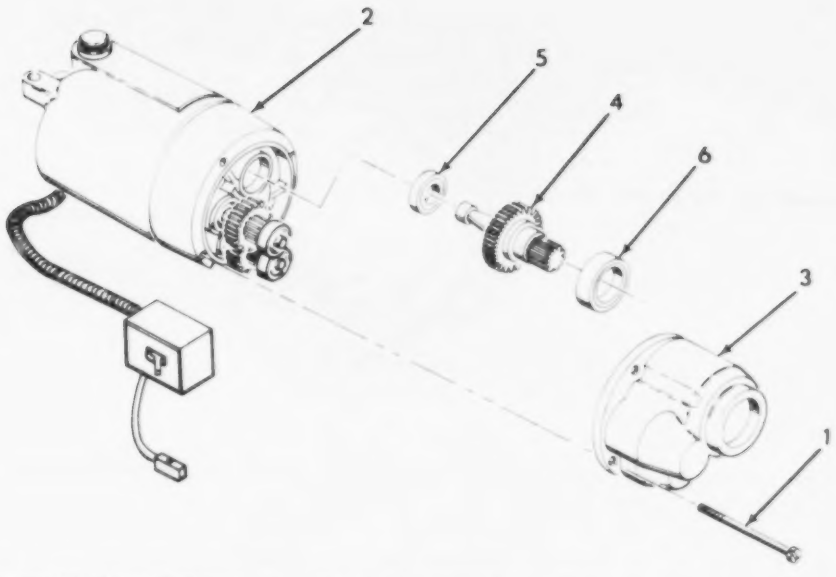
Separate ring gear (1) from chuck. Examine ring gear and replace if it is worn or has any broken teeth. Lubricate ring gear with GAA wheel bearing grease.



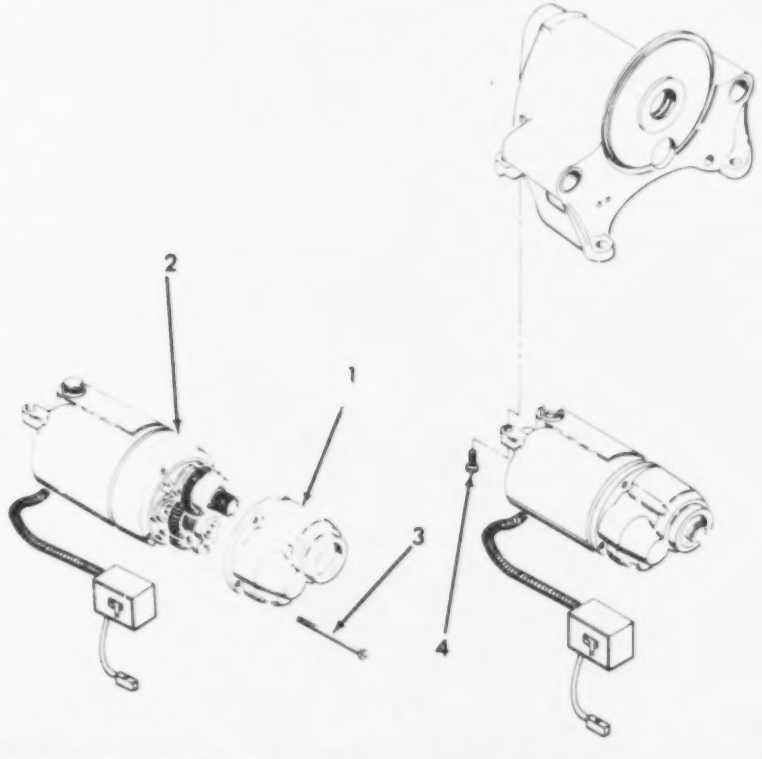
If ring gear is bad, replace drive gear (1) as well as ring gear.



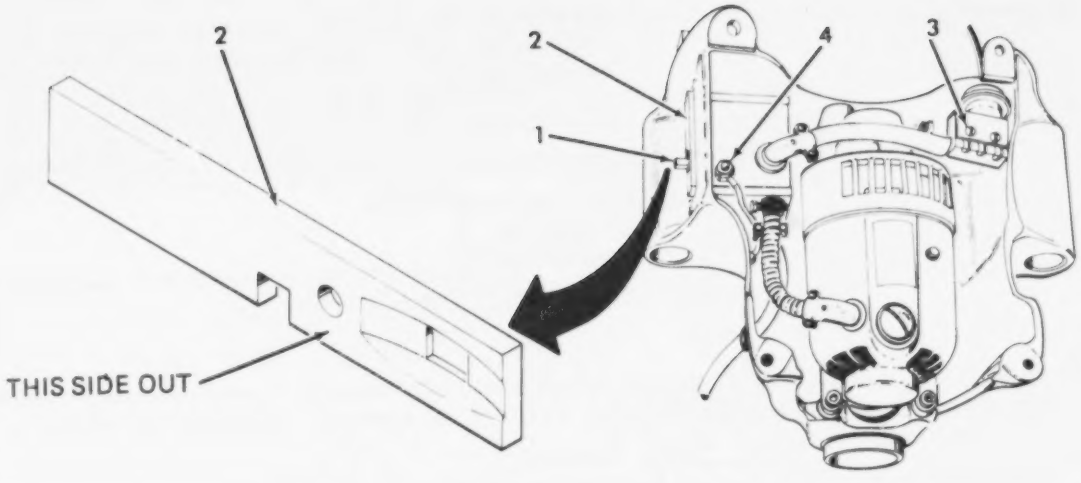
To replace the drive gear, the motor must be removed. To remove the motor, remove the three hex cap screws (1) which hold it in place. Remove the two screws (2) which hold the micro-switch to the air diaphragm. Remove the two screws (3) which hold the selector switch to the machine body. Disconnect the ground wire (4) from the machine body. Pry the motor out of the machine body.



Remove the four screws (1) which hold the sections of the gear case (2) and (3) together. Remove the front section of the gear case. Remove the main drive gear assembly (4) including front and rear bearings (5) (6). Lubricate the new gear and bearings with GAA grease and position them in the gear case.



Line up the front section of the gear case (1) with the rest of the gear case (2) and insert the screws (3) and tighten them. Insert the motor back into the hose coupling assembler. Install the three large screws (4) which mount the motor to the hose coupling assembler.

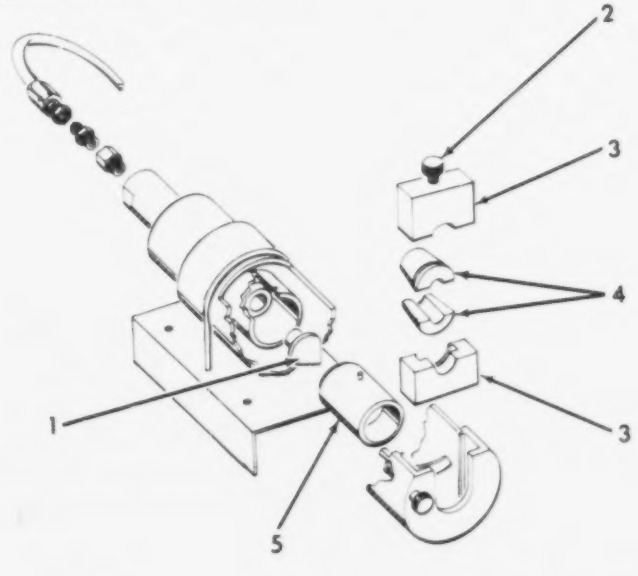


Reinstall the reversing switch (1). Be sure that the safety interlock bar (2) is in place with the tapered edges facing outward (if installed incorrectly, the guard cannot be opened). Re-attach the micro-switch (3) to the hand switch air diaphragm. Re attach the ground wire (4) to tne machine body. Reinstall the guard, vise and guide rods, and tighten the collars into place. Check the guard interlock to be sure it opens only when the reversing switch is off. Re-connect the hand switch air hose. Set the machine upright, plug it in, and operate it to be sure the gears are not binding. Lift the tool into place on the sliding rack and fasten it with the four mounting bolts. Attach the power cord clamp to the wall and stow the cord.

c. Replacement. Paragraph 4-9b describes how to replace the hose coupling assembler.

4-10. Tube Flaring Tool. The following paragraphs descri' e repairs of the tube flaring tool.

a. Flaring Cone. Inspect the face of the flaring cone (1) for nicks, cracks, or scratches. If any severe mars or marks are found, replace the flaring cone. To replace the flaring cone, loosen the knob pin (2) and remove the die retainer assembly (3) and die set (4). Slide the die ring (5) out and remove the flaring cone (1). Install the new flaring cone and reassemble the tube flaring tool by reversing the above procedure.



CAUTION

BE SURE THAT THE FLARING CONE, INNER SURFACES OF THE DIE RINGS, AND OUTER SURFACES OF THE DIE SETS ARE PROPERLY LUBRICATED BEFORE USING THE TOOL.

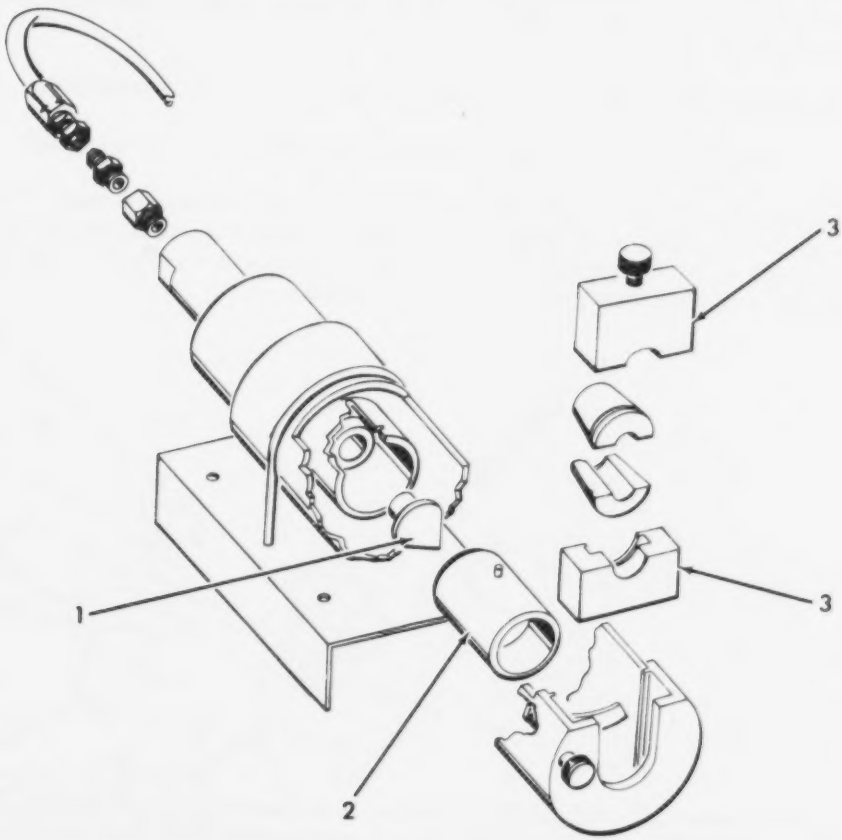
NOTE

WHILE THE TOOL IS DISASSEMBLED, LUBRICATE THE CONE.

b. Flaring Dies. Inspect the inside diameters of the flaring dies (1) for nicks and scratches. Inspect the flaring dies for evidence of cracks. Lubricate the outside of the dies. Replace the dies as necessary. Do not allow any lubricant to get on the inner surfaces of the dies.

c. Die Ring. Inspect the die ring (2) for nicks, scratches, and cracks. Lubricate the inside diameter of the ring. Replace the ring as necessary. See paragraph 4-10a for removal procedures.

d. Die Retainer Assembly. Inspect the die retainer assembly (3) as necessary. See paragraph 4-10a for removal procedures.

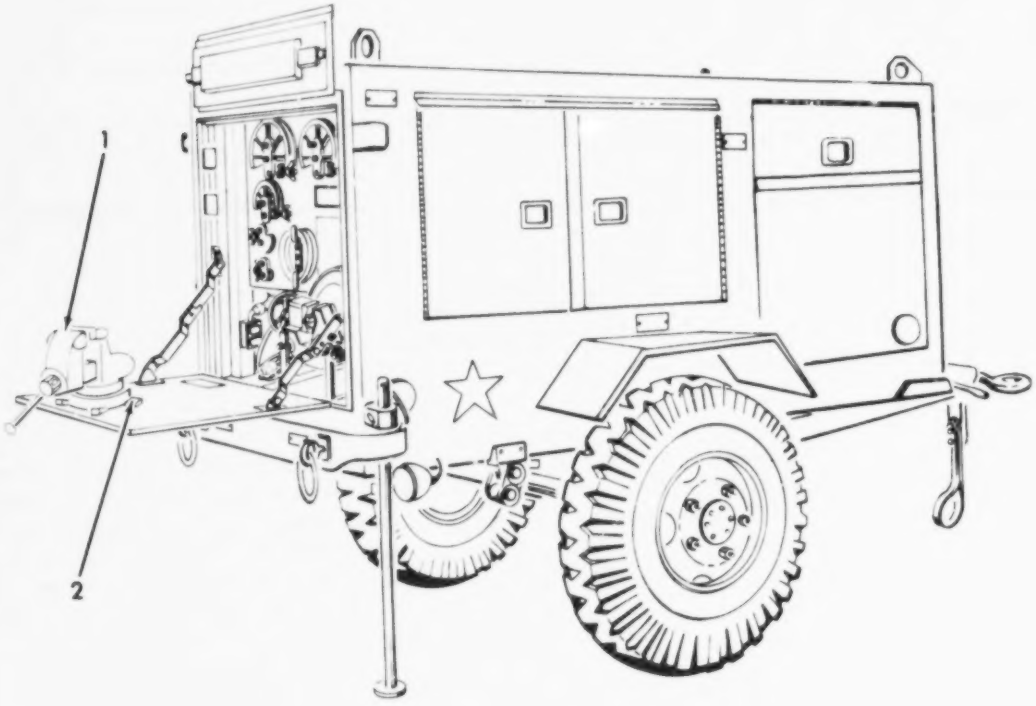


4-11. Machinists' Vise. If the machinists' vise (1) on the rear work table of the HSTRU needs to be replaced, remove four bolts (2) which mount it to the work table.

WARNING

USE PROPER LIFTING TECHNIQUES.

Lift the vise off the work table and mount the new vise.



4-12. Hand Pump.

a. *Replace.* To replace the hand pump, use the following procedure:

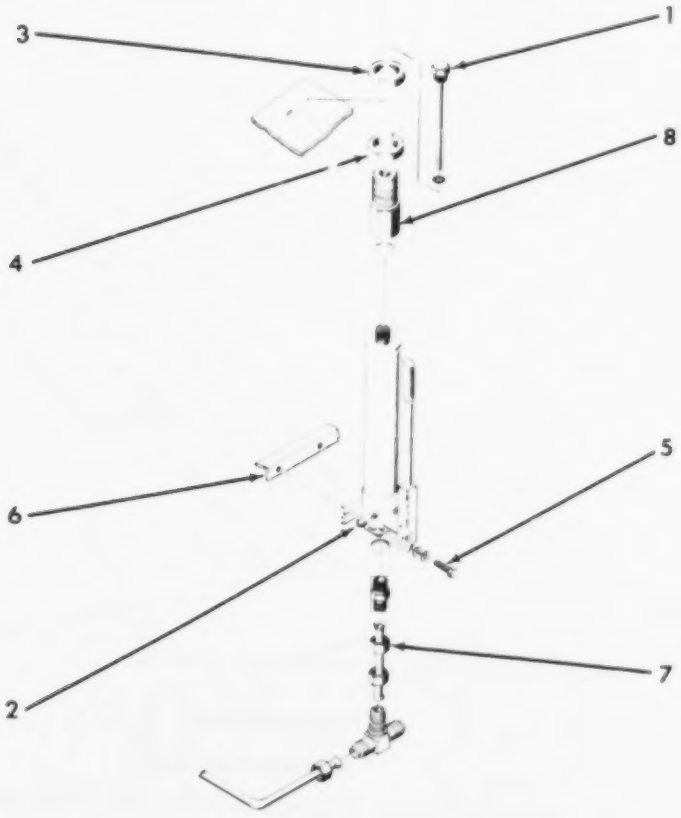
WARNING

MAKE SURE ALL PRESSURE HAS BEEN RELIEVED PRIOR TO DISCONNECTING HYDRAULIC LINES.

1. Remove the dipstick (1).
2. Open the bypass valve (2).
3. Remove the retaining nut (3). Screw nut (4) all the way down.
4. Remove the two hex head bolts (5) which hold the hand pump to the mounting bracket (6).
5. Disconnect the line (7) to the TEE from the outlet port of the pump.
6. Unscrew the adapter (8).
7. Lift the hand pump out of the HSTRU.

NOTE

THIS IS A TWO (2) MAN OPERATION.



8. Place the new hand pump in the HSTRU.

9. Be sure nut (4) is screwed all the way down on adapter (8). Screw the adapter (8) onto the hand pump. Do not tighten.

10. Install and tighten the two hex head bolts (5).

11. Screw the adapter (8) tight on the hand pump.

12. Screw nut (4) up against the top of the HSTRU.

13. Screw retaining nut (3) onto the adapter and tighten it.

14. Reconnect the line (7) which goes to the TEE. Tighten it.

15. Fill the hand pump with oil and test the hand pump (PMCS 11).

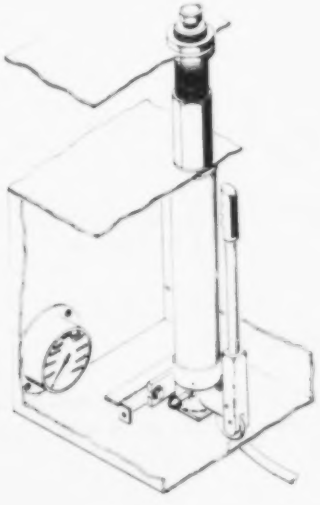
b. Repair. Limited repairs may be performed on the hand pump. If the handle is bent it may be unscrewed, straightened in the vise and reinstalled.

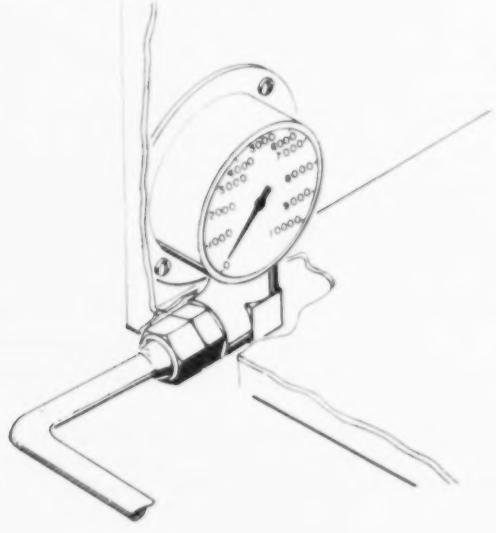
4-13. Pressure Gage. To replace the pressure gage, first open the hand pump flow valve to relieve the pressure then close it.

WARNING

MAKE SURE PRESSURE HAS BEEN RELIEVED PRIOR TO DISCONNECTING ANY LINES.

Below the bulkhead which the gage is mounted on, there is a tube assembly which connects an elbow on the back of the gage to a "tee" fitting in the hand pump output line. Locate and remove this tube assembly. Remove the elbow from the bottom of the gage connector. Remove the three large screws and spacers which hold the gage to the bulkhead and lift the gage out. Set the new gage in place and insert the three large screws and spacers. Cover the threads of the elbow with pipe thread sealant and screw the elbow into the bottom of the pressure gage connector. Connect the tube assembly to the elbow and the "tee".





SECTION II

GENERAL SUPPORT MAINTENANCE

4-14. General. This section contains general support maintenance instructions for the HSTRU.

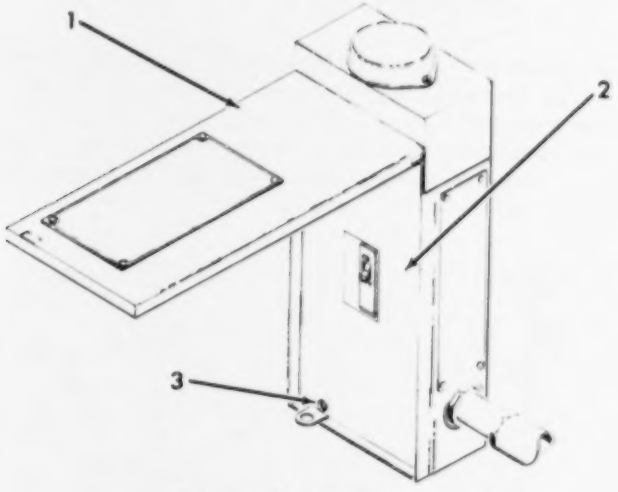
4-15. Circuit Breaker Box. In some cases, such as because of severe intergranular corrosion, it may become necessary to replace the circuit breaker box.

WARNING

BEFORE WORKING ON THE CIRCUIT BREAKER BOX, BE SURE THAT ELECTRICAL POWER HAS BEEN DISCONNECTED FROM THE HSTRU AND THAT THE TRAILER IS PROPERLY GROUNDED.

BE SURE THE FIRE EXTINGUISHER IS DEPLOYED AND READILY AVAILABLE FOR USE BEFORE YOU BEGIN WORKING ON THE ELECTRICAL SYSTEM.

To replace the circuit breaker box, open the face of the box (1) and unscrew the face plate (2). One large screw (3) holds the face plate in place.



CAUTION

TAG EACH WIRE FOR PROPER RECONNECTION.

After the face plate is removed, disconnect and cap the wiring to the circuit breakers. Then disconnect the conduits from the box. After this is done, remove the rivets holding the box to the enclosure brace and remove the box from the trailer. Reverse the above procedure to install a new box.

WARNING

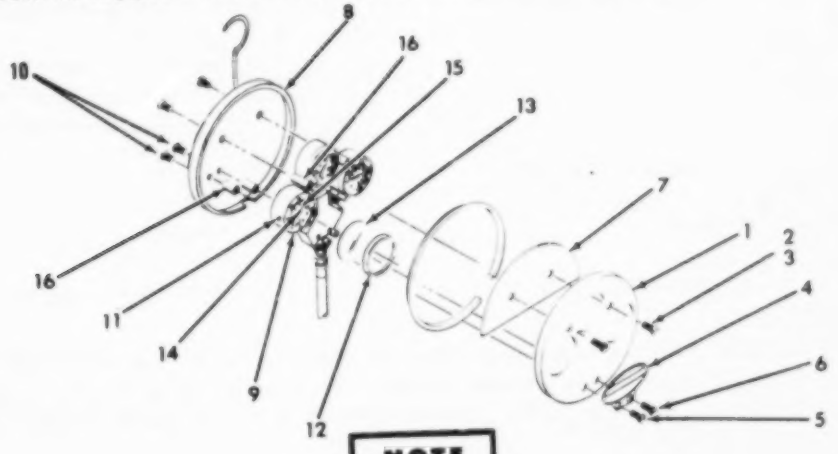
BE SURE THE HSTRU IS PROPERLY GROUNDED PRIOR TO TESTING ELECTRICAL CIRCUITS.

BE SURE THE FIRE EXTINGUISHER IS READY FOR USE PRIOR TO APPLYING ELECTRICAL POWER.

After the new box has been installed and the electrical circuits have been connected, carefully check each circuit to ensure that it operates correctly.

4-16. Multi-Range Pressure Gage. Calibrate the multi-range pressure gage in accordance with TB-9-4931-228-50, "Calibration Procedures for Compound and Vacuum Gages, Marsh Types 2 and 3." If the low range gage adjustment proves to be incorrect, it may be "zeroed" by using the following procedure. Calibration shall be scheduled and performed in accordance with Calibration Requirements for Maintenance of Army Material, TB-43180.

a. Low Range Gage. Inspect the gage and see if the pointer (needle) is in the zero ("0") position when the gage is not in use. If the pointer does not zero, remove the front cover and two spacers by removing the two screws (2), (3) holding the name tag (4) to the front of the gage. Then, remove the other two screws (5), (6) from the front of the gage case. Lift the plastic shield (7) off the gage faces. Remove two lower screws (10) from back of case. Lift the gage main body (8) out and unscrew the low range pressure gage (9). Loosen the two screws (11) on the side of the low range pressure gage (9) body. Slide the retaining ring (12) and gage sight glass (13) off the gage. Using a small screwdriver, turn the slotted screw (14) in the center of the gage face until the pointer (15) points to zero. To reassemble the multi-range gage, place the low range gage sight glass (13) in the retaining ring (12). Line up the "notches" in the retaining ring with the two screws (11) on the sides of the gage body (9). Install the retaining ring and glass and tighten the screws. Attach main body to gage rear case with screws (10). Line up the holes in the plastic shield (7) with the two large spacers (16) which are between the gages and are attached to the gage rear case (8). Reposition small spacers (16).



NOTE

IF THE LARGE RUBBER GROMMET WHICH GOES BETWEEN THE CASE HALVES HAS BEEN REMOVED, REINSTALL IT.

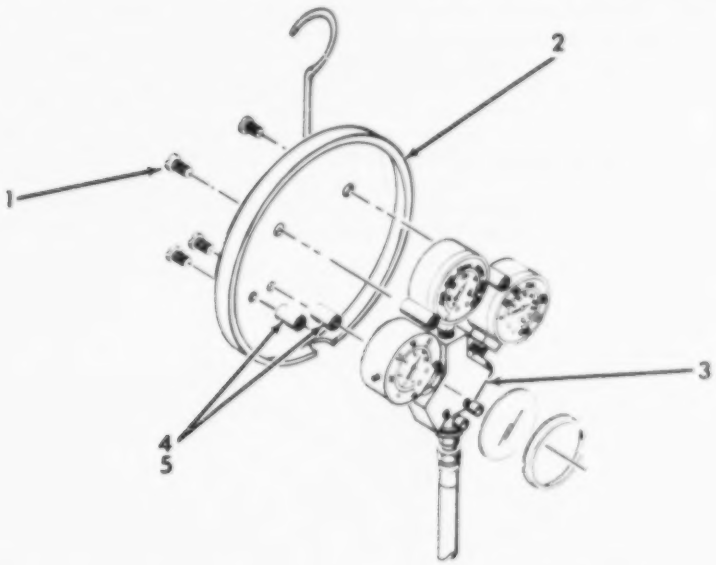
Line up the front cover (1) and the name tag (4) with the rest of the gage. Install and tighten the four front cover screws (2), (3), (5), (6).

b. Medium and High Range Gages. The medium range and high range pressure gages in the multi-range pressure unit cannot be adjusted. If they read incorrectly or inaccurately during calibration, they must be replaced. Using the procedures in paragraph 4-16a, remove the gage unit front cover. Remove the slotted screws (1) from the gage rear case (2). This will free the gage housing (3) from the case. At this time, the spacers (4 & 5) will also come loose. Grasp the housing in a vise and using a large open end wrench unscrew the gage which needs to be replaced.

NOTE

IT MAY BE NECESSARY TO REMOVE ALL THREE (3) GAGES.

Coat the fitting threads of the new gage with loctite and screw it into the housing. Tighten the new gage to 250 ft. lbs. torque. To reassemble the gage, assemble the rear case (2) to the gage housing (3) and spacers (4) (5) by installing the four screws (1). Refer to paragraph 4-16a for the remainder of the reassembly instructions.



4-17. Proof Pressure System Pressure Gage. Calibrate the proof pressure system periodically in accordance with Army calibration policies and procedures. To adjust this gage, use standard adjustment procedures for liquid filled Bourdon type instruments (see TB 9-6685-319-50, "Calibration Procedures for Dial Indicating Pressure Gages, General").

NOTE

THIS GAGE MUST BE CALIBRATED AND ADJUSTED UNDER CONTROLLED CONDITIONS.

4-18. Hydraulic System Tester.

a. Calibration. Refer to TB-9-4910-532-50 "Calibration Procedure for Portable Hydraulic System Tester".

b. Repair. The most common malfunction associated with the hydraulic system test is a ruptured blowout plug. If the blowout plug ruptures, shut the system being tested down immediately and remove the tester from the system. See paragraph 3-15c for replacement procedure. Refer to TM9-4940-468-24P for an illustrated parts breakdown of the hydraulic system tester.

APPENDIX A

REFERENCES

A-1. SCOPE

This appendix lists all forms and technical manuals referenced in this manual.

A-2. TECHNICAL MANUALS

Arctic Operations TM9-207

Chemicals and Chemical Products. C68001L

Fuels, Lubrication, Oil and Waxes. C91001L

Hydraulic Power Controls Systems TM5-350

Operator, Organizational, Direct Support and General Support Maintenance Manual with Repair Parts and Special Tools List (RPSTL) for Trailer, Cargo 3/4 ton, 2-wheel, M116A1 . . . . . TM9-2330-202-14 & P

Organizational, Direct Support and General Support Maintenance Repair Parts and Special Tools List for Tool Outfit, Hydraulic Test and Repair (HSTRU) Model 1000 . . . . . TM9-4940-468-24P

Painting Instructions for Field Use . . . . . TM 43-0139

The ARMY Maintenance Management Systems TM38-750

A-3. TECHNICAL BULLETINS

Calibration Procedures for Compound and Vacuum Gages, Marsh Types 2 and 3. . . . . TB9-4931-228-50

Calibration Procedures for Dial Indicating Pressure Gages, General TB9-6685-319-50

Calibration Procedure for Portable Hydraulic System Tester. TB9-4910-532-50

Hand Portable Fire Extinguishers for Army Users . . . . . TB 5-4200-200-10

A-4. FORMS

Equipment Improvement Recommendation SF368

Recommended Changes to Publications DA2028

A-5. MILITARY SPECIFICATIONS

Hose, Rubber and Hose Assembly,
Rubber (Hydraulic, Flexible) MIL-H-13531

Hydraulic Fluid, Petroleum Base;
Aircraft, Missile, and Ordnance MIL-H-5606

Lubricating Oil, Internal Combustion
Engine, Tactical Service MIL-L-2104

APPENDIX B

MAINTENANCE ALLOCATION CHART

Section I. Introduction

B-1. General.

a. This section provides a general explanation of all maintenance and repair functions authorized at various maintenance levels.

b. The Maintenance Allocation Chart (MAC) in Section II designates overall responsibility for the performance of maintenance functions on the identified end item or component. The implementation of the maintenance functions upon the end item or component will be consistent with the assigned maintenance functions.

c. Section III lists the special tools and test equipment required for each maintenance function as referenced from Section II.

d. Section IV contains supplemental instructions or explanatory notes for a particular maintenance function.

B-2. Maintenance Functions.

a. *Inspect.* To determine the serviceability of an item by comparing its physical, mechanical and/or electrical characteristics with established standards through examination.

b. *Test.* To verify serviceability and detect incipient failure by measuring the mechanical or electrical characteristics of an item and comparing those characteristics with prescribed standards.

c. *Service.* Operations required periodically to keep an item in proper operating condition, i.e., to clean (decontaminate), to preserve, to drain, to paint, or to replenish fuel, lubricants, hydraulic fluids, or compressed air supplies.

d. *Adjust.* To maintain, within prescribed limits, by bringing into proper or exact position, or by setting the operating characteristics to specified parameters.

e. *Align.* To adjust specified variable elements of an item to bring about optimum or desired performance.

f. *Calibrate.* To determine and cause corrections to be made or to be adjusted on instruments or test measuring and diagnostic equipments used in precision measurement. Consists of comparisons of two instruments, one which is a certified standard of known accuracy, to detect and adjust any discrepancy in the accuracy of the instrument being compared.

g. *Install.* The act of emplacing, seating, or fixing into position an item, part, or module (component or assembly) in a manner to allow the proper functioning of an equipment or system.

h. *Replace.* The act of substituting a serviceable like type part, subassembly, or module (component or assembly) for an unserviceable counterpart.

i. *Repair.* The application of maintenance services (inspect, test, service, adjust, align, calibrate, or replace) or other maintenance actions (welding, grinding, riveting, straightening, facing, remachining, or resurfacing) to restore serviceability to an item by correcting specific damage, fault, malfunction, or failure in a part, subassembly, module (component or assembly), and item, or system.

j. *Overhaul.* That maintenance effort (services/actions) necessary to restore an item to a completely serviceable/operational condition as prescribed by maintenance standards (i.e., DMWR) in appropriate technical publications. Overhaul is normally the highest degree of maintenance performed by the Army. Overhaul does not normally return an item to like new condition.

k. *Rebuild.* Consists of those services/actions necessary for the restoration of unserviceable equipment to a like new condition in accordance with original manufacturing standards. Rebuild is the highest degree of material maintenance applied to Army Equipment. The rebuild operation includes the act of returning to zero those age measurements (hours/miles, etc.) considered in classifying Army equipments/components.

B-3. Column Entries Used in the MAC.

a. *Column 1, Group Number.* Column 1 lists group numbers, the purpose of which is to identify components, assemblies, subassemblies, and modules with the next higher assembly.

b. *Column 2, Component/Assembly.* Column 2 contains the names of components, assemblies, subassemblies, and modules for which maintenance is authorized.

c. *Column 3, Maintenance Functions.* Column 3 lists the functions to be performed on the item listed in column 2. (For detailed explanation of these functions, see paragraph B-2.)

d. *Column 4, Maintenance Level.* Column 4 specifies, by the listing of a work time figure in the appropriate subcolumn(s), the lowest level of maintenance authorized to perform the function listed in column 3. This figure represents the active time required to perform the maintenance function at the indicated level of maintenance. If the number or complexity of the tasks within the listed maintenance function vary at different maintenance levels, appropriate work time figures will be shown for each level. The number of man-hours specified by the work time figure represents the average time required to restore an item (assembly, subassembly, component, module, end item, or system) to a serviceable condition under typical field operating conditions. This time includes preparation time, troubleshooting time, and quality assurance/quality control time in addition to the time required to perform the specific tasks identified for the maintenance functions authorized in the maintenance allocation chart. The symbol designations for the various maintenance levels are as follows:

C	Operator or crew
O	Organization maintenance
F	Direct support maintenance
H	General support maintenance
D	Depot maintenance

e. *Column 5, Tools and Equipment.* Column 5 specifies, by code, those common tool sets (not individual tools) and special tools, test, and support equipment required to perform the designated function.

f. *Column 6, Remarks.* This column shall contain a letter code in alphabetical order which shall be keyed to the remarks contained in Section IV.

B-4. Column Entries Used in Tool and Test Equipment Requirements.

a. *Column 1, Tool or Test Equipment Reference Code.* The tool and test equipment reference code correlates with a maintenance function on the identified end item or component.

b. *Column 2, Maintenance Level.* The lowest level of maintenance authorized to use the tool or test equipment.

c. *Column 3, Nomenclature.* Name or identification of the tool or test equipment.

d. *Column 4, National/NATO Stock Number.* The National or NATO stock number of the tool or test equipment.

e. *Column 5, Tool Number.* The manufacturer's part number.

B-5. Explanation of Columns in Section IV.

a. *Reference Code.* The code scheme recorded in column 6, Section II.

b. *Remarks.* This column lists information pertinent to the maintenance function being performed as indicated on the MAC, Section II.

Section II. MAINTENANCE ALLOCATION CHART

(1) Group Number	(2) Component/Assembly	(3) Maintenance Function	(4) Maintenance Level C	O	F	H	D	(5) Tools and Equipment	Remarks
01	TRAILER, CARGO, 3/4 Ton, 2-wheel, M116A1. See TM9-2330-202-14&P								
02	TRAILER BODY								
0201	Doors	Inspect	0.1						
		Service	0.1						
		Replace			1.0				
		Repair		1.0				1, 3, 4, 7	A, C
0202	Fenders	Inspect	0.1						
		Replace			1.0			1, 2	A, C
0203	Stabilizer Leg	Inspect	0.1						
		Replace		0.2					
0204	Reflectors, Identification Plates, Lift Eyes	Inspect	0.1						
		Replace		0.5				1, 2, 3	A, C
0205	Sliding Rack	Inspect	0.1						
		Service	0.2						
		Replace			0.4				
		Repair			1.0			1, 2, 7	A, C
0206	Radius Block Pins	Inspect	0.1						
		Service	0.1						
		Replace		0.1				1	A
0207	Shelving	Inspect	0.2						
		Repair			1.0				
03	ELECTRICAL DISTRIBUTION SYSTEM								
0301	Breaker Box	Inspect	0.1						
		Replace				3.0		7	A
030101	Circuit Breaker	Inspect	0.1						
		Test	0.1						
		Replace			0.1			8	A
0302	Elec. Connectors	Inspect	0.1						
		Replace			0.2			3	A

Section II. MAINTENANCE ALLOCATION CHART (Continued)

(1) Group Number	(2) Component/Assembly	(3) Maintenance Function	(4) Maintenance Level C	O	F	H	D	(5) Tools and Equipment	Remarks
0303	Elec. Outlets & Switches	Inspect Test Replace	0.1		0.1 1.0			8	A
0304	Elec. Lines	Inspect Test Replace	0.1		1.0 0.5			4, 8	A, C
04	SOLVENT CLEANING SYSTEM								
0401	Solvent Tank	Inspect Service Replace	0.1	1.0	1.0			1, 2, 5	A, B, C
0402	Filter	Inspect Replace	0.1 0.1						
0403	Hose & Nozzle	Inspect Replace	0.1	0.1				1	A
0404	Solvent Pump	Inspect Test Replace	0.1 0.1		1.0			1, 2	A, C
0405	Breather	Inspect Replace	0.1	0.1				1	A
0406	Tray, Cleaning Solvent	Inspect Replace	0.1		1.0			1, 2, 3	A, C
05	ELECTRICAL TOOLS								
0501	Hose Coupling Assembler	Inspect Replace Repair	0.1		1.0 1.0			1, 2, 3, 8	A, C
0502	Hose Cutter Assembly	Inspect Replace Repair	0.1		0.1 1.0			1, 3, 5, 8	A, B
0503	Transfer Pump	Inspect Replace Repair	0.1 1.0		0.1			1, 2	A, C
0504	Impact Wrench	Inspect Replace	0.1		0.1				

Section II. MAINTENANCE ALLOCATION CHART (Continued)

(1) Group Number	(2) Component/Assembly	(3) Maintenance Function	(4) Maintenance Level C	O	F	H	D	(5) Tools and Equipment	Remarks
06	HYDRAULIC TOOLS								
0601	Tube Flaring Tool	Inspect	0.1						
		Service	0.1						
		Repair		0.1					
		Replace			0.1			1	A
07	HAND TOOLS								
0701	Tube Bender	Inspect	0.1						
		Service	0.1						
		Repair		1.0					
		Replace			0.1			1, 2, 3, 5, 6, 8	A, B, C
0702	Hose Skiving Tool	Inspect	0.1						
		Replace		0.1					
		Repair		0.1				1	A
0703	Deburring Tool	Inspect	0.1						
		Replace		0.1					
		Repair		0.1				7, 8	A
0704	Vise, 3½ inch	Inspect	0.1						
		Service	0.1						
		Replace			0.2			1, 2	A, C
0705	Vise, Tube Cutting	Inspect	0.1						
		Service	0.1						
		Replace		0.1					
0706	Ferrule Setting Tool	Inspect	0.1						
		Replace		0.1					
08	ACCESSORIES								
0801	Adapter Kit	Inspect	0.2						
080101	Adapters	Replace		0.2					
0802	System Flushing Filter								
080201	Filter Element	Inspect	0.1						
		Replace	0.1						
0803	Drop Light	Inspect	0.1						
		Replace		0.1				1, 3	A
080301	Bulb	Test	0.1						
		Replace	0.1						

Section II. MAINTENANCE ALLOCATION CHART (Continued)

(1) Group Number	(2) Component/Assembly	(3) Maintenance Function	(4) Maintenance Level C	O	F	H	D	(5) Tools and Equipment	Remarks
0804	O-Ring Kit	Inspect	0.1						
	O-rings	Replace		0.1					
0805	O-ring Fabrication Kit	Inspect	0.1						
		Replace		0.1					
080501	Adhesive	Replace		0.1					
080502	Cord	Replace		0.1					
0806	Plumbing Fabrication Components	Inspect	0.3						
080601	Hose	Replace	0.1						
080602	Hose Couplings	Replace	0.2						
080603	Tubing	Replace	0.2						
080604	Tube Fittings	Replace	0 2						
09	TEST EQUIPMENT								
0901	Proof Pressure System								
090101	Hand Pump	Inspect	0.1						
		Service	0.1						
		Replace			0.3				
		Repair			0.2			1, 2, 7	A, C
090102	Gage, Pressure	Inspect	0.1						
		Replace			0.5			1, 2, 8	A, C
		Calibrate				1.0			
0902	Gage, Multi-range	Inspect	0.1						
		Replace		0.1					
		Calibrate				1.0			
		Repair				3.0		1, 8	A
0903	Tester, Hydraulic	Inspect	0.1						
		Replace		0.1					
		Calibrate				2.0			
		Repair				4.0		1, 7	A

Section III. TOOL AND TEST EQUIPMENT REQUIREMENTS

(1) Reference	(2) Maintenance	(3) Nomenclature	(4) National/NATO stock number	(5) Tool number
1	O, F	Wrench, Adj, 12 in.	5120-00-264-3796	N/A
2	O, F	Wrench, Socket Set 3/18 Sq Dr	5120-00-322-6231	N/A
3	O, F	Screwdriver, Cross Tip, Size 2	5120-00-234-8913	N/A
4	F	Pliers, Needle Nose, With Cutter 6½"	5120-00-184-9403	N/A
5	O, F	Key Wrench, (Allen) Socket Head Set	5120-00-529-1475	N/A
6	F	Hammer, Ball Peen	5120-00-061-8546	N/A
7	O, F	Screwdriver, Fit, 6" lg 5/16w	5120-00-278-1283	N/A
8	O, F	Screwdriver, Fit, 4" lg 1/4w	5120-00-278-1282	N/A

Section IV. REMARKS

Maintenance Allocation Chart

Reference code	Remarks
A	This tool is included in Box Three (3) of the Tool Outfit.
B	This tool is included in Box Four (4) of the Tool Outfit.
C	This tool is included in Box Seven (7) of the Tool Outfit.

APPENDIX C

EXPENDABLE SUPPLIES AND MATERIALS LIST

SECTION I. INTRODUCTION

1. Scope.

This appendix lists expendable supplies and materials you will need to operate and maintain the HSTRU. These items are authorized to you by CTA 50-970.

2. Explanation of Columns.

a. Column 1 - Item Number. Not Applicable.

b. Column 2 - Level. This column identifies the lowest level of maintenance that requires the listed item.

C - Operator/Crew
O - Organizational Maintenance
F - Direct Support Maintenance
H - General Support Maintenance

c. Column 3 - National Stock Number. This is the National stock number assigned to the item: use it to request or requisition the item.

d. Column 4 - Description. Indicates the Federal item name and, if required a description to identify the item. The last line for each item indicates the part number followed by the Federal Supply Code for Manufacturer (FSCM) in parentheses, if applicable.

e. Column 5 - Unit of Measure (UM). Indicates the measure used in performing the actual maintenance function. This measure is expressed by a two-character alphabetical abbreviation (e.g. ea. in. pr.). If the unit of measure differs from the unit of issue, requisition the lowest unit of issue that will satisfy your requirements.

(1) ITEM NUMBER	(2) LEVEL	(3) NATIONAL STOCK NUMBER	(4) DESCRIPTION	(5) U/M
	C		Blade, Hand Hack Saw, High Speed, Steel, 10 in. lg., 32 teeth per inch, GGG-B-451, Class 1	EA
	C		Blade, Hand Hack Saw, Rod Shaped, Tungston Carbide, GGG-B-451	SET
	C		Blade, Cut-off Saw, Hose	EA
	C		Blades, Tube Deburring 226 30780	SET
	C	4730-00-930-4525	Coupling, Hose, 4 Bolt Split Flange, Straight, 1 Inch MS 39286-16C 96906	EA
	C	4730-00-477-9764	Coupling, Hose, 4 Bolt Split Flange, Straight, 1-1/4 Inch MS 39286-20C 96906	EA
	C	4730-00-482-4039	Coupling, Hose, 4 Bolt Split Flange, Straight, 1-1/2 Inch MS 39286-24C 96906	EA
	C	4730-00-930-4526	Coupling, Hose, 4 Bolt Split Flange, 45° Bend, 1 Inch MS 39287-16C 96906	EA
	C		Coupling, Hose, 4 Bolt Split Flange, 45° Bend, 1-1/4 Inch MS 39287-20C 96906	EA
	C		Coupling, Hose, 4 Bolt Split Flange, 45° Bend, 1-1/2 Inch MS 39287-24C 96906	EA
	C		Coupling, Hose, 4 Bolt Split Flange, 90° Bend, 1 Inch MS 39288-16C 96906	EA
	C	4730-00-930-5394	Coupling, Hose, 4 Bolt Split Flange, 90° Bend, 1-1/4 Inch MS 39288-20C 96906	EA
	C		Coupling, Hose, 4 Bolt Split Flange, 90° Bend, 1-1/2 Inch MS 39288-24C 96906	EA
	C		Coupling, Hose, 1/4 Inch, Straight, Female 5/16 Inch 37° Flare MS 39290-5-4B 96906	EA
	C	4730-00-455-8650	Coupling, Hose, 3/8 Inch, Straight, Female 3/8 Inch 37° Flare MS 39290-6-6B 96906	EA
	C	4730-00-451-2703	Coupling, Hose, 1/2 Inch, Straight, Female 1/2 Inch 37° Flare MS 39290-8-8B 96906	EA
	C	4730-00-369-4065	Coupling, Hose, 1/2 Inch, Straight, Female 5/8 Inch 37° Flare MS 39290-10-8B 96906	EA

(1) ITEM NUMBER	(2) LEVEL	(3) NATIONAL STOCK NUMBER	(4) DESCRIPTION	(5) U/M
	C	4730-00-472-2611	Coupling, Hose, 3/4 Inch, Straight, Female 3/4 Inch 37° Flare MS 39290-12-12B 96906	EA
	C		Coupling, Hose, 1/4 Inch, 45° Bend, Female 5/16 Inch 37° Flare MS 39291-5-4B 96906	EA
	C		Coupling, Hose, 3/8 Inch, 45° Bend, Female 3/8 Inch 37° Flare MS 39291-6-6B 96906	EA
	C	4730-01-017-3284	Coupling, Hose, 1/2 Inch, 45° Bend, Female 1/2 Inch 37° Flare MS 39291-8-8B 96906	
	C		Coupling, Hose, 1/2 Inch, 45° Bend, Female 5/8 Inch 37° Flare MS 39291-10-8B 96906	EA
	C	4730-00-930-4524	Coupling, Hose, 3/4 Inch, 45° Bend, Female 3/4 Inch 37° Flare MS 39291-12-12B 96906	EA
	C		Coupling, Hose, 1/4 Inch, 90° Bend, Female 5/16 Inch 37° Flare MS 39292-5-4B 96906	EA
	C	4730-01-007-2641	Coupling, Hose, 3/8 Inch, 90° Bend, Female 3/8 Inch 37° Flare MS 39292-6-6B 96906	EA
	C	4730-00-451-4620	Coupling, Hose, 1/2 Inch, 90° Bend, Female 1/2 Inch 37° Flare MS 39292-8-8B 96906	EA
	C		Coupling, Hose, 1/2 Inch, 90° Bend, Female 5/8 Inch 37° Flare MS 39292-10-8B 96906	EA
	C	4730-00-451-2704	Coupling, Hose, 3/4 Inch, 90° Bend, Female 3/4 Inch 37° Flare MS 39292-12-12B 96906	EA
	C		Door Seal Lubricant G-624	OZ
	C		Element, Filter, Solvent 13221E6797 97403	EA
	C		Element, Filter, Flushing 13221E6725 97403	EA
	C		Element, Filter, Transfer Pump 13221E6758 97403	EA
	C		Grease, Artillery and Automotive (GAA)	OZ

(1) ITEM NUMBER	(2) LEVEL	(3) NATIONAL STOCK NUMBER	(4) DESCRIPTION	(5) U/M
	C	4720-01-017-6127	Hose, Rubber, Double Wire Braid, 1/4 Inch MS 39263-4 96906	FT
	C	4720-00-289-2615	Hose, Rubber, Double Wire Braid, 3/8 Inch MS 39263-6 96906	FT
	C	4720-01-018-6550	Hose, Rubber, Double Wire Braid, 1/2 Inch MS 39263-8 96906	FT
	C	4720-00-080-3085	Hose, Rubber, Double Wire Braid, 3/4 Inch MS 39263-12 96906	FT
	C		Hose, Rubber, Four Spiral Wrap, 1 Inch MS 39264-16 96906	FT
	C	4720-00-432-7204	Hose, Rubber, Four Spiral Wrap, 1-1/4 Inch MS 39264-20 96906	FT
	C		Hose, Rubber, Four Spiral Wrap, 1-1/2 Inch MS 39264-24 96906	FT
	C		Lubricating Oil, Internal Combination Engine, 10 Weight (OE)	QT
	C		Lubricating Oil, Internal Combination Engine, Heavy Duty, 50 Weight (HDO)	QT
	C		Lubricant, Semi-Fluid, Automatic Weapon (LSA)	OZ
	C		Motor Brushes, Hose Coupling Assembly Machine E1491 87373	SET
	C		Motor Brushes, Saw, Hose Cut-off 23963 01276	SET
	C	4730-00-314-8366	Nut, Tube Coupling, 37° Flared, 1/4 Inch MS 51531B4 96906	EA
	C	4730-00-897-2042	Nut, Tube Coupling, 37° Flared, 5/16 Inch MS 51531B5 96906	EA
	C	4730-01-024-7933	Nut, Tube Coupling, 37° Flared, 3/8 Inch MS 51531B6 96906	EA
	C	4730-00-762-1239	Nut, Tube Coupling, 37° Flared, 1/2 Inch MS 51531B8 96906	EA
	C	4730-00-897-2043	Nut, Tube Coupling, 37° Flared, 5/8 Inch MS 51531B10 96906	EA
	C	4730-00-812-0924	Nut, Tube Coupling, 37° Flared, 3/4 Inch MS 51531B12 96906	EA
	C		Nut, Tube Coupling, 37° Flared, 7/8 Inch MS 51531B14 96906	EA

(1) ITEM NUMBER	(2) LEVEL	(3) NATIONAL STOCK NUMBER	(4) DESCRIPTION	(5) U/M
	C	4730-01-037-4714	Nut, Tube Coupling, 37° Flared, 1 Inch MS 51531B16 96906	EA
	C		Nut, Tube Coupling, 37° Flared, 1-1/4 Inch MS 51531B20 96906	EA
	C	4730-00-038-7015	Nut, Tube Coupling, Flareless, 1/4 Inch MS 51823-3 96906	EA
	C	4730-00-800-8151	Nut, Tube Coupling, Flareless, 5/16 Inch MS 51823-4 96906	EA
	C	4730-00-025-7508	Nut, Tube Coupling, Flareless, 3/8 Inch MS 51823-5 96906	EA
	C	4730-00-463-0689	Nut, Tube Coupling, Flareless, 1/2 Inch MS 51823-6 96906	EA
	C	4730-00-153-7045	Nut, Tube Coupling, Flareless, 5/8 Inch MS 51823-7 96906	EA
	C	4730-00-460-2086	Nut, Tube Coupling, Flareless, 3/4 Inch MS 51823-8 96906	EA
	C		Nut, Tube Coupling, Flareless, 7/8 Inch MS 51823-9 96906	EA
	C	4730-01-027-3987	Nut, Tube Coupling, Flareless, 1 Inch MS 51823-10 96906	EA
	C	4730-00-564-3265	Nut, Tube Coupling, Flareless, 1-1/4 Inch MS 51823-11 96906	EA
	C		Kit O-Ring 13221E6834 97403	EA
	C	5330-00-803-7208	Packing, O-Ring MS28778-2 96906	EA
	C	5330-00-835-7485	Packing, O-Ring MS28778-3 96906	EA
	C	5330-00-805-2966	Packing, O-Ring MS28778-4 96906	EA
	C	5330-00-833-7491	Packing, O-Ring MS28778-5 96906	EA
	C	5330-00-804-5695	Packing, O-Ring MS28778-6 96906	EA
	C	5330-00-808-0794	Packing, O-Ring MS28778-8 96906	EA
	C	5330-00-285-9842	Packing, O-Ring MS28778-10 96906	EA

(1) ITEM NUMBER	(2) LEVEL	(3) NATIONAL STOCK NUMBER	(4) DESCRIPTION	(5) U/M
	C	5330-00-251-8839	Packing, O-Ring MS28778-12 96906	EA
	C	5330-00-472-2783	Packing, O-Ring MS28778-14 96906	EA
	C	5330-00-804-5694	Packing, O-Ring MS28778-16 96906	EA
	C	5330-00-816-3546	Packing, O-Ring MS28778-20 96906	EA
	C	5330-00-819-5111	Packing, O-Ring MS28778-24 96906	EA
	C	5330-01-049-7374	Packing, O-Ring MS28778-032 96906	EA
	C	5330-00-292-0570	Packing, O-Ring MS28778-210 96906	EA
	C	5330-00-579-3163	Packing, O-Ring MS28778-214 96906	EA
	C	5330-00-579-7925	Packing, O-Ring MS28778-219 96906	EA
	C	5330-00-297-9990	Packing, O-Ring MS28778-222 96906	EA
	C	5330-00-579-7927	Packing, O-Ring MS28778-225 96906	EA
	C	5330-00-807-8993	Packing, O-Ring MS28778-228 96906	EA
	C	5330-00-585-8247	Packing, O-Ring MS28778-232 96906	EA
	C	5330-00-608-6432	Packing, O-Ring MS28778-237 96906	EA
	C		Sealant, Hydraulic MIL-S-22473 HVV	OZ

(1) ITEM NUMBER	(2) LEVEL	(3) NATIONAL STOCK NUMBER	(4) DESCRIPTION	(5) U/M
	C	4730-00-004-4265	Sleeve, Flareless, 1/4 Inch MS 51825-3 96906	EA
	C	4730-01-030-8691	Sleeve, Flareless 5/16 Inch MS 51825-4 96906	EA
	C	4730-00-800-3129	Sleeve, Flareless, 3/8 Inch MS 51825-5 96906	EA
	C	4730-00-463-0686	Sleeve, Flareless, 1/2 Inch MS 51825-6 96906	EA
	C	4730-00-146-0333	Sleeve, Flareless, 5/8 Inch MS 51825-7 96906	EA
	C	4730-00-462-7781	Sleeve, Flareless, 3/4 Inch MS 51825-8 96906	EA
	C	4730-00-477-5822	Sleeve, Flareless, 7/8 Inch MS 51825-9 96906	EA
	C	4730-00-800-2579	Sleeve, Flareless, 1 Inch MS 51825-10 96906	EA
	C	4730-00-800-2581	Sleeve, Flareless, 1-1/4 Inch MS 51825-11 96906	EA
	C	4730-01-043-6300	Sleeve, 37° Flared, 1/4 Inch MS 51533 B4 96906	EA
	C	4730-01-045-2686	Sleeve, 37° Flared, 5/16 Inch MS 51533 B5 96906	EA
	C	4730-01-025-4161	Sleeve, 37° Flared, 3/8 Inch MS 51533 B6 96906	EA
	C	4730-00-314-7754	Sleeve, 37° Flared, 1/2 Inch MS 51533 B8 96906	EA
	C	4730-00-895-2975	Sleeve, 37° Flared, 5/8 Inch MS 51533 B10 96906	EA
	C	4730-00-565-3011	Sleeve, 37° Flared, 3/4 Inch MS 51533 B12 96906	EA
	C		Sleeve, 37° Flared, 7/8 Inch MS 51533 B14 96906	EA
	C	4730-00-595-3225	Sleeve, 37° Flared, 1 Inch MS 51533 B16 96906	EA
	C		Sleeve, 37° Flared, 1-1/4 Inch MS 51533 B20 96906	EA
	C		Solvent	

(1) ITEM NUMBER	(2) LEVEL	(3) NATIONAL STOCK NUMBER	(4) DESCRIPTION	(5) U/M
	C		Splicing Kit, O-Ring 13221E6722 97403	EA
	C		Adhesive, Quick Set 404 05972	OZ
	C		Tubing, Carbon Steel, 0.25 OD, .035 Wall SAE J525	FT
	C		Tubing, Carbon Steel, 0.31 OD, .035 Wall SAE J525	FT
	C		Tubing, Carbon Steel, 0.38 OD, .035 Wall SAE J525	FT
	C		Tubing, Carbon Steel, 0.50 OD, 0.49 Wall SAE J525	FT
	C		Tubing, Carbon Steel, 0.62 OD, 0.65 Wall SAE J525	FT
	C		Tubing, Carbon Steel, 0.75 OD, .065 Wall SAE J525	FT
	C		Tubing, Carbon Steel, 1.00 OD, .109 Wall SAE J525	FT
			Tubing, Carbon Steel, 1.25 OD, .120 Wall SAE J525	FT
	C		Union, Tube, 37° Flared, 1/4 Inch MS 51501 B4 96906	EA
	C		Union, Tube, 37° Flared, 5/16 Inch MS 51501 B5 96906	EA
	C		Union, Tube, 37° Flared, 3/8 Inch MS 51501 B6 96906	EA
	C		Union, Tube, 37° Flared, 1/2 Inch MS 51501 B8 96906	EA
	C		Union, Tube, 37° Flared, 5/8 Inch MS 51501 B10 96906	EA
	C		Union, Tube, 37° Flared, 3/4 Inch MS 51501 B12 96906	EA
	C		Union, Tube, 37° Flared, 7/8 Inch MS 51501 B14 96906	EA
	C		Union, Tube, 37° Flared, 1 Inch MS 51501 B16 96906	EA

APPENDIX D

TOOL BOX PACKING

Box Number	QTY	Description	Part Number
1	1	Tool Box Left Hand	13221E6838
	2	Adapter, Tube to Hose, 45° stem, Sz. 1.00	MS39287-16C
	1	Adapter, Tube to Hose, 45° stem, Sz. 1.25	MS39287-20C
	1	Adapter, Tube to Hose, 90° stem, Sz. 1.25	MS39288-20C
	1	Adapter, Tube to Hose, 90° stem, Sz. 1.50	MS39288-24C
	1	Adapter Kit, 4-Bolt, Split Flange, Sz. 1.00	MS39296-16C
	1	Adapter Kit, 4-Bolt, Split Flange, Sz. 1.25	MS39296-20C
	4	Adapter, Tube to Hose, Straight, Sz. 1.00	MS39286-16C
	2	Adapter, Tube to Hose, Straight, Sz. 1.25	MS39286-20C
	4	Coupling, Hose	MS20630-16-16
2	1	Tool Box, Right Hand	13221E6836
	2	Adapter, Straight, Pipe to Tube	MS51500B4
	2	Adapter, Straight, Pipe to Tube	MS51500B4-4
	2	Adapter, Straight, Pipe to Tube	MS51500B5
	2	Adapter, Straight, Pipe to Tube	MS51500B5-4
	2	Adapter, Straight, Pipe to Tube	MS51500B6
	2	Adapter, Straight, Pipe to Tube	MS51500B6-6
	2	Adapter, Straight, Pipe to Tube	MS51500-B8
	2	Adapter, Straight, Pipe to Tube	MS51500B8-8
	2	Adapter, Straight, Pipe to Tube	MS51500B10
	2	Adapter, Straight, Pipe to Tube	MS51500B12-8
	2	Adapter, Straight, Pipe to Tube	MS51500B12
	2	Adapter, Straight, Pipe to Tube	MS51500B14
	2	Adapter, Straight, Pipe to Tube	MS51500B16-12
	2	Adapter, Straight, Pipe to Tube	MS51500B16
	2	Adapter, Straight, Pipe to Tube	MS51500B20
	2	Union, Tube	MS51501B4
	2	Union, Tube	MS51501B5
	2	Union, Tube	MS51501B6
	2	Union, Tube	MS51501B8
	2	Union, Tube	MS51501B10
	2	Union, Tube	MS51501B12
	2	Union, Tube	MS51501B14
	2	Union, Tube	MS51501B16
	4	Nut, Tube, Coupling	MS51531B4
	4	Nut, Tube, Coupling	MS51531B5
	4	Nut, Tube, Coupling	MS51531B6
	4	Nut, Tube, Coupling	MS51531B8
	4	Nut, Tube, Coupling	MS51531B10
	4	Nut, Tube, Coupling	MS51531B12
	4	Nut, Tube, Coupling	MS51531B14
	4	Nut, Tube, Coupling	MS51531B16
	4	Nut, Tube, Coupling	MS51531B20
	4	Sleeve, Compression, Tube Fitting	MS51533B4

Box Number	QTY	Description	Part Number
2	4	Sleeve, Compression, Tube Fitting	MS5153385
	4	Sleeve, Compression, Tube Fitting	MS5153386
	4	Sleeve, Compression, Tube Fitting	MS5153388
	4	Sleeve, Compression, Tube Fitting	MS51533810
	4	Sleeve, Compression, Tube Fitting	MS51533812
	4	Sleeve, Compression, Tube Fitting	MS51533814
	4	Sleeve, Compression, Tube Fitting	MS51533816
	4	Sleeve, Compression, Tube Fitting	MS51533820
	4	Nut, Tube, Flareless	MS51823-3
	4	Nut, Tube, Flareless	MS51823-4
	4	Nut, Tube, Flareless	MS51823-5
	4	Nut, Tube, Flareless	MS51823-6
	4	Nut, Tube, Flareless	MS51823-7
	4	Nut, Tube, Flareless	MS51823-8
	4	Nut, Tube, Flareless	MS51823-9
	4	Nut, Tube, Flareless	MS51823-10
	4	Nut, Tube, Flareless	MS51823-11
	4	Sleeve, Tube, Flareless	MS51825-3
	4	Sleeve, Tube, Flareless	MS51825-4
	4	Sleeve, Tube, Flareless	MS51825-5
	4	Sleeve, Tube, Flareless	MS51825-6
	4	Sleeve, Tube, Flareless	MS51825-7
	4	Sleeve, Tube, Flareless	MS51825-8
	4	Sleeve, Tube, Flareless	MS51825-9
	4	Sleeve, Tube, Flareless	MS51825-10
	4	Sleeve, Tube, Flareless	MS51825-11
	1	Nipple Flared Tube & Pipe	AN816-16
	1	Nipple Flared Tube & Pipe	AN816-20
	1	Nipple Flared Tube & Pipe	AN816-25
	1	Reducer	AN919-23
	1	Union	AN815-12
3	1	Tool Box Left Hand	13221E6838
	1	Wrench, Open End 7/16	VS-5214
	1	Wrench, Open End 9/16	VS-5218
	1	Wrench, Open End 5/8	VS-5220
	1	Wrench, Open End 1/2	5120-00-289-8209
	1	Wrench, Open End 11/16	5120-00-293-1796
	1	Wrench, Open End 3/4	5120-00-293-0053
	1	Wrench, Open End 13/16	5120-00-184-8652
	1	Wrench, Open End 7/8	5120-00-184-8653
	1	Wrench, Open End 15/16	5120-00-184-8654
	1	Wrench, Open End 1	5120-00-293-1794
	1	Wrench, Open End 1-1/16	5120-00-293-2136
	1	Wrench, Open End 1-1/8	5120-00-595-9017
	1	Wrench, Open End 1-1/4	5120-00-293-1795
	1	Wrench, Open End 1-3/8	5120-00-289-8210
	1	Wrench, Open End 1-1/2	5120-00-289-8212
	1	Wrench, Adjustable, 12 in.	5120-00-264-3796
	1	Wrench, Adjustable, 15 in.	5120-00-423-6728
	1	Wrench, Adjustable, 18 in.	5120-00-240-1414

Box Number	QTY	Description	Part Number
3	1	Tape Measure	5120-00-541-3324
	1	Rule, Steel, 6 in.	5120-00-273-1965
	1	Stop Watch	6645-00-250-4680
	1	Screw Driver, Cross Tip, Sz 1	5210-00-240-8716
	1	Screw Driver, Cross Tip, Sz 2	5120-00-234-8913
	1	Screw Driver, Cross Tip, Sz 3	5120-00-234-8912
	1	Screw Driver, Cross Tip, Sz 4	5120-00-224-7375
	1	Pliers, Slip Joint, STR Nose	5120-00-223-7397
	2	Handle, File	5110-00-263-0341
	1	File, Thread, Restorer	5110-00-516-3812
	1	File, Thread, Restorer	5110-00-373-1691
	1	Holder Inserted Hammer Face	5120-00-554-7757
	2	Face, Hammer, Insert, Screw in	5120-00-540-4273
	1	Hammer, Ball Peen	5120-00-061-8546
	1	Bar, Pry 15-16 in.	5120-00-224-1389
	1	Frame, Hack Saw	5110-00-289-9657
	1	Blade, Hack Saw, Rod Shape RS-12c	5110-00-927-1063
	1	File, Half Round, 12 in.	5110-00-241-9156
	1	File, Flat, 12 in.	5110-00-203-4936
	1	Brush, File Cleaner	7920-00-224-7987
	1	Screw Driver Offset	5120-00-287-2130
	1	Screw Driver	5120-00-222-8866
	1	Screw Driver	5120-00-236-2140
	1	Screw Driver	5120-00-278-1282
	1	Screw Driver	5120-00-278-1283
	1	Blade Hack Saw, High Speed Steel	5110-00-142-4928
4	1	Tool Box Left Hand	13221E6838
	1	Tool, Ferrule Setting, 1/4 in.	560578
	1	Tool, Ferrule Setting, 5/16 in.	560579
	1	Tool, Ferrule Setting, 3/8 in.	560580
	1	Tool, Ferrule Setting, 1/2 in.	560581
	1	Tool, Ferrule Setting, 5/8 in.	560582
	1	Tool, Ferrule Setting, 3/4 in.	560583
	1	Tool, Ferrule Setting, 7/8 in.	560584
	1	Tool, Ferrule Setting, 1 in.	560585
	1	Tool, Ferrule Setting, 1-1/4 in.	560586
	1 set	Motor Brushes, Hose Coupling Machine	E1491
	1 set	Motor Brushes, Cut-Off Saw	23963
	1	Blade, Cut-Off Saw	300583
	1	Impact Wrench, Electric	5120-00-595-9259
	1	Chuck, Collet Type	441-J9
	1	Extension Anvil, 6 in.	508-6
	1	Universal Joint, 1/2 in.	—
	1	Sleeve, Morse No. 1 to Morse No. 2 Taper	60212
	1	Socket, Morse No. 2 Taper	SJ-409-2
	1	Socket Wrench, Hex, 7/16	5114
	1	Socket Wrench, Hex, 1/2	5116
	1	Socket Wrench, Hex, 9/16	5118
	1	Socket Wrench, Hex, 5/8	5120

Box Number	QTY	Description	Part Number
4	1	Socket Wrench, Hex, 11/16	5122
	1	Socket Wrench, Hex, 3/4	5124
	1 set	Key, Socket HD Screw, 11 Long Wrenches	5120-00-529-1475
	1	Key Wrench, Socket Head 1/2	5120-00-198-5407
	1	Key Wrench, Socket Head 9/16	5120-00-198-5404
	1	Key Wrench, Socket Head 5/8	5120-00-198-5405
	1	Key Wrench, Socket Head 3/4	5120-00-198-5402
	1	Key Wrench, Socket Head 1	5120-00-198-5403
	1	Wrench, Blade, Cut-Off Saw	—
	1 set	Pins, Hose Locating, Cut-Off Saw	—
5	1	Tool Box Left Hand	13221E6838
	1 set	Caps, Vise Jaw	13221E6819-1
	1 bottle	Sealant, Hydraulic	MIL-S-22473 HVV
	1 gal.	Oil-Lubricating	ADC 1078
	8 oz.	Door Seal Lubricant	G-624
6	1	Fitting Kit, Hydraulic	13221E6833
	1	Tee Int. Pipe/Int. Pipe, Sz. 4	NU7048
	1	Tee Int. Pipe/Int. Pipe, Sz 6	NU7118
	1	Tee Int. Pipe/Int. Pipe, Sz 8	NU7119
	1	Tee Int. Pipe/Int. Pipe, Sz. 12	NU7120
	1	Tee Int. Pipe/Int. Pipe, Sz. 16	NU7121
	1	Tee Int. Pipe/Int. Pipe, Sz. 20	NU6118
	1	Tee Int. Pipe/Int. Pipe, Sz. 24	NU7122
	1	Nip Ext. Pipe/Ext. Pipe, Sz. 4	NU0706
	1	Nip Ext. Pipe/Ext. Pipe, Sz. 6	NU6457
	1	Nip Ext. Pipe/Ext. Pipe, Sz. 8	NU6458
	1	Nip Ext. Pipe/Ext. Pipe, Sz. 12	NU6459
	1	Nip Ext. Pipe/Ext. Pipe, Sz. 16	NU6460
	1	Nip Ext. Pipe/Ext. Pipe, Sz. 20	NU6461
	1	Nip Ext. Pipe/Ext. Pipe, Sz. 24	NU6462
	2	Ext. Pipe/Int. Pipe, Sz. 2-4	NU6471
	2	Ext. Pipe/Int. Pipe, Sz. 4-6	NU7046
	1	Ext. Pipe/Int. Pipe, Sz. 8-12	NU6473
	1	Ext. Pipe/Int. Pipe, Sz. 16-20	NU7123
	2	Red. Ext. Pipe/Int. Pipe, Sz. 2-4	NU6236
	1	Red. Ext. Pipe/Int. Pipe, Sz. 4-6	NU0336
	1	Red. Ext. Pipe/Int. Pipe, Sz. 4-8	NU0746
	1	Red. Ext. Pipe/Int. Pipe, Sz. 4-12	NU0747
	1	Red. Ext. Pipe/Int. Pipe, Sz. 8-12	NU7126
	1	Red. Ext. Pipe/Int. Pipe, Sz. 8-16	NU6478
	1	Red. Ext. Pipe/int. Pipe, Sz. 12-20	NU6479
	1	Red. Ext. Pipe/Int. Pipe, Sz. 16-20	NU6480
	1	Red. Ext. Pipe/Int. Pipe, Sz. 16-24	NU6481
	1	Int. Pipe/Sae "O" R'G Boss, Sz. 4-4	NU6525
	1	Int. Pipe/Sae "O" R'G Boss, Sz. 4-6	NU1403
	1	Int. Pipe/Sae "O" R'G Boss, Sz. 8-8	NU7254
	1	Int. Pipe/Sae "O" R'G Boss, Sz. 8-10	NU6484

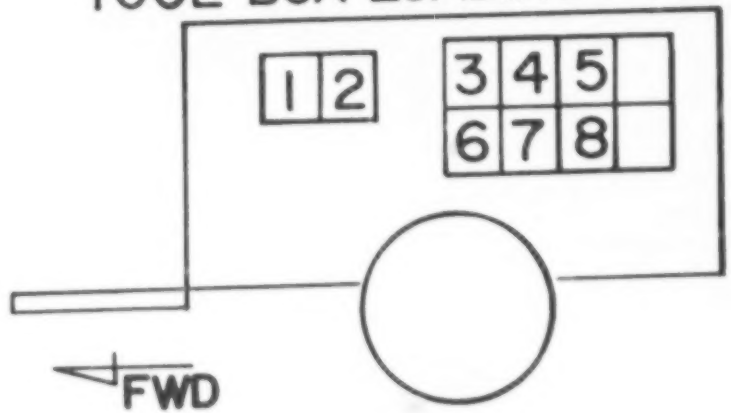
Box Number	QTY	Description	Part Number
6	1	Int. Pipe/Sae "O" R'G Boss, Sz. 12-12	NU0765
	1	Int. Pipe/Sae "O" R'G Boss, Sz. 12-14	NU7127
	1	Int. Pipe/Sae "O" R'G Boss, Sz. 16-16	NU6485
	1	Int. Pipe/Sae "O" R'G Boss, Sz. 16-20	NU6486
	1	Adapter-Flareless, Sz. 4	NU7129
	1	Adapter-Flareless, Sz. 5-4	NU7130
	1	Adapter-Flareless, Sz. 6	NU7131
	1	Adapter-Flareless, Sz. 8	NU7132
	1	Adapter-Flareless, Sz. 8-8	NU7133
	1	Adapter-Flareless, Sz. 10	NU7134
	1	Adapter-Flareless, Sz. 12	NU7135
	1	Adapter-Flareless, Sz. 16	NU7136
	1	Adapter-Flareless, Sz. 20	NU7137
	1	Adapter-Flareless, Sz. 24	NU7138
	8	Bolt Hex Head, Sz. 5/16-18	NU1507
	8	Bolt Hex Head, Sz. 3/8-16	NU0811
	8	Bolt Hex Head, Sz. 7/16-14	NU0812
	8	Bolt Hex Head, Sz. 1/2-13	NU0813
	8	Hex Nut, Sz. 5/16-18	NU1033
	8	Hex Nut, Sz. 3/8-16	NU6604
	8	Hex Nut, Sz. 7/16-14	NU0985
	8	Hex Nut, Sz. 1/2-13	NU7205
	1	Ext. Pipe/37° Flare, Sz. 16-24	NU7140
	1	Split Flange/37° Flare, Sz. 8	NU2206
	1	Split Flange/37° Flare, Sz. 12	NU2321
	1	Split Flange/37° Flare, Sz. 16	NU6126
	1	Split Flange/37° Flare, Sz. 20	NU2322
	1	Split Flange/37° Flare, Sz. 24	NU2325
	1	37° Flare (Int. Red.) 37° Flare, Sz. 16-20	NU1025
	1	37° Flare (Int. Red.) 37° Flare, Sz. 20-24	NU6335
	1	Ext. Pipe/Int. Pipe, Sz. 8	NU6520
	1	Ext. Pipe/Int. Pipe, Sz. 12	NU6521
	1	Ext. Pipe/Int. Pipe, Sz. 16	NU6522
	1	Ext. Pipe/Int. Pipe, Sz. 20	NU7154
	1	Ext. Pipe/Int. Pipe, Sz. 24	NU7155
	1	Ext. Pipe/Plug, Sz. 2	NU6501
	1	Ext. Pipe/Plug, Sz. 4	NU6502
	1	Ext. Pipe/Plug, Sz. 6	NU1105
	1	Ext. Pipe/Plug, Sz. 8	NU1106
	1	Ext. Pipe/Plug, Sz. 12	NU1107
	1	Ext Pipe/Plug, Sz. 16	NU1124
	1	Ext. Pipe/Plug, Sz. 20	NU6503
	1	Cap Nut, Sz. 4	NU0026
	1	Cap Nut, Sz. 5	NU6504
	1	Cap Nut, Sz. 6	NU0030
	1	Cap Nut, Sz. 8	NU0020
	1	Cap Nut, Sz. 10	NU1240
	1	Cap Nut, Sz. 12	NU0022
	1	Cap Nut, Sz. 16	NU1371
	1	Cap Nut, Sz. 20	NU1018
	1	Cap Nut, Sz. 24	NU6338

Box Number	QTY	Description	Part Number
6	1	Flareless-Plug, Sz. 4	NU7141
	1	Flareless-Plug, Sz. 5	NU7142
	1	Flareless-Plug, Sz. 6	NU7143
	1	Flareless-Plug, Sz. 8	NU7144
	1	Flareless-Plug, Sz. 10	NU7145
	1	Flareless-Plug, Sz. 12	NU7146
	1	Flareless-Plug, Sz. 16	NU7147
	1	Flareless-Plug, Sz. 20	NU7148
	1	Special Flange, Sz. 8	NU7149
	1	Special Flange, Sz. 12	NU7150
	1	Special Flange, Sz. 16	NU7151
	1	Special Flange, Sz. 20	NU7152
	1	Special Flange, Sz. 24	NU7153
	1	Male Connector, Sz. 24x16	NU7128
	1	Reducer, Sz. 16x8	NU7124
	1	Reducer, Sz. 24x20	NU7125
	2	Connector Plates, Sz. 1/2	NU7255
	2	Connector Plates, Sz. 3/4	NU7256
	2	Connector Plates, Sz. 1	NU7257
	2	Connector Plates, Sz. 1-1/4	NU7258
	2	Connector Plates, Sz. 1-1/2	NU7259
	1	Adapter 3/8 NPT Male to 1/2 NPT Female	NU7327
7	1	Tool Box Left Hand	13221E6838
	1	Wrench Set, 12 PT. Box	XV-611-K
	1	Pliers, Snap Ring	5120-00-789-0492
	1	Wrench Set Socket, 12 PT. 3/8 Sq. Dr.	5120-00-322-6231
	1	Pliers, Slip Joint, Angle Nose	5120-00-278-0352
	1	Pliers, Round Needle Nose	5120-00-184-9403
	2	Screw Driver	5120-00-227-7362
8	1	Tool Box Left Hand	13221E6838
	1	Element, Filter	13221E6725
	2	Element, Filter	13221E6758
	2	Element, Filter	13221E6797
	2	Adapter	MS51525B16
	2	O-Ring	MS28778-16
9	1	Tool Box Right Hand	13221E6836
	1	Splicing Kit, O-Ring	13221E6722
	1	Grease, Lubricating 7 oz.	MIL-G-4343
	1	Packing Kit, O-Ring	13221E6834
10	1	Tool Box Right Hand	13221E6836
	1	Can, 1 PT., Screw Cap	8110-00-178-8280

Box Number	QTY	Description	Part Number
10	1	Can, Screw Cap, 1 Gal.	8110-00-879-7182
	4 qts.	Oil	MIL-L-2104
	1	Funnel, Copper	7240-00-286-8776
	2	Lamp, 100 W, White	6240-00-617-1739
	2	Lamp, 100 W, Blue	6240-00-944-2375
	1	Tool Bender Handle	621063
	1	Tie Bar, Tube Bender	621084
11	1	Tool Box Right Hand	13221E6836
	1	Circuit Tester, Hydraulic, Portable	13221E6829
12	1	Tool Box Right Hand	13221E6836
	1	Vise, Tubing	13221E6826
	1	Goggles, Safety	4240-00-269-7912
	1	Gloves, Work	8415-00-268-7859
	1	Hose Perforator	13221E6723
	1	Tube Deburrer	13221E6827
	1	Skiving Cutter	13221E6732
	1 set	Deburring Blades	226 Blades
	1	Tool, Hose Skiving	751126
	1	Tachometer	13221E6666
	1	Mandrel .25 DIA	13221E6717-5-1
	1	Mandrel .38 DIA	13221E6717-5-2
	1	Mandrel .50 DIA	13221E6717-5-3
	1	Mandrel .75 DIA	13221E6717-5-4
	1	Mandrel 1.00 DIA	13221E6717-5-5
	1	Mandrel 1.25 DIA	13221E6717-5-6
	1	Mandrel 1.50 DIA	13221E6717-5-7
13	1	Tool Box Right Hand	13221E6836
	2	Adapter, Tube to Hose, Straight, Sz. 1.50	MS39286-24C
	2	Adapter, Tube to Hose, 90° Stem, Sz. 1.00	MS39288-16C
	4	Adapter, Tube to Hose, Straight, Sz. .31	MS39290-5-4B
	4	Adapter, Tube to Hose, Straight, Sz. .38	MS39290-6-6B
	4	Adapter, Tube to Hose, Straight, Sz. .50	MS39290-8-8B
	2	Adapter, Tube to Hose, Straight, Sz. .62	MS39290-10-8B
	4	Adapter, Tube to Hose, Straight, Sz. .75	MS39290-12-12B
	2	Adapter, 45° Stem, Sz. .31	MS39291-5-4B
	2	Adapter, 45° Stem, Sz. .38	MS39291-6-6B
	2	Adapter, 45° Stem, Sz. .50	MS39291-8-8B
	2	Adapter, 45° Stem, Sz. .62	MS39291-10-8B
	2	Adapter, 45° Stem, Sz. .75	MS39291-12-12B
	2	Adapter, 90° Stem, Sz. .31	MS39292-5-4B
	2	Adapter, 90° Stem, Sz. .38	MS39292-6-6B
	2	Adapter, 90° Stem, Sz. .50	MS39292-8-8B
	2	Adapter, 90° Stem, Sz. .62	MS39292-10-8B
	2	Adapter, Tube to Hose, 90° Stem, Sz. .75	MS39292-12-12B

Box Number	QTY	Description	Part Number
13	1	Adapter Kit, 4-Bolt, Split Flange, Sz. 1.50	MS39296-24C
	1	Adapter, Tube to Hose, 45° Stem, Sz. 1.50	MS39287-24C
14	1	Tool Box Right Hand	13221E6836
	1	Hydraulic Tube Flarer	710400
	1	Die Set .25 OD	710417-4
	1	Die Set .31 OD	710417-5
	1	Die Set .38 OD	710417-6
	1	Die Set .50 OD	710417-8
	1	Die Set .62 OD	710417-10
	1	Die Set .75 OD	710417-12
	1	Die Set .88 OD	710417-14
	1	Die Set 1.00 OD	710417-16
	1	Die Set 1.25 OD	710417-20
	1	Die Ring	710416
	1	Flaring Cone	710419
	1	Die Retainer Assy	710424-1
	15 oz. can	Lubricating Oil	STP
	1	Straight Thread Adapter	8-3/8 F50G-S
	1	Male Adapter	6-6-FTX-S

TOOL BOX LOADING DIAGRAM

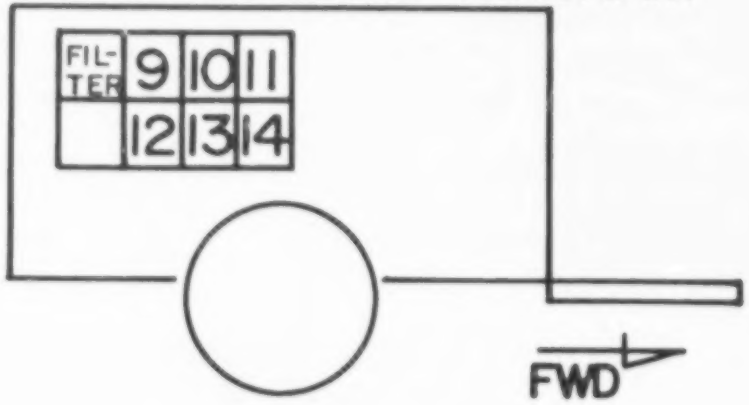


LEGEND

1. HOSE ADAPTER KIT NO. 1 55 LBS.
2. TUBE FITTING KIT NO. 2 37 LBS.
3. OPEN END & ADJUSTABLE WRENCHES, SCREW DRIVERS, PLIERS, MEASURING TOOLS, WATCH, FILES HAMMERS, SAW & PRY BAR 41 LBS.
4. FERRULE SETTING TOOLS, IMPACT WRENCH & ACCESSORIES, CUT-OFF SAW, ACCESSORIES KEY WRENCHES, & MOTOR BRUSHES 39 LBS.
5. SEALANT, LUBRICANTS, & VISE JAW CAPS 23 LBS.
6. ADAPTER KIT EQUIPMENT TROUBLE SHOOTING 70 LBS.
7. BOX END WRENCHES, SNAP RING PLIERS, LARGE SCREW DRIVERS & SLIP JOINT & NEEDLE NOSE PLIERS 32 LBS.
8. FILTER ELEMENT, REPLACEMENT 16 LBS.

FIGURE D-1, TOOL BOX LOADING DIAGRAM (SHEET 1 OF 2).

TOOL BOX LOADING DIAGRAM



LEGEND

9. "O" RING KITS 15 LBS.
10. OIL CAN, FUNNEL & REPLACEMENT LAMPS 19 LBS.
11. CIRCUIT TESTER KIT 34 LBS.
12. TUBING VISE, GOGGLES, GLOVES PERFORATOR, DEBURRER, TACHOMETER SKIVING TOOL & ACCESSORIES 31 LBS.
13. HOSE ADAPTER KIT NO. 2 58 LBS.
14. TUBE FLARING KIT 68 LBS.

FIGURE D-1, TOOL BOX LOADING DIAGRAM (SHEET 2 OF 2).

INDEX

SUBJECT — Page

A

Abbreviations ... 1-3
Accessory Maintenance ... 1-22, 1-24, 2-110
Adapter Kit, Troubleshooting ... 2-114
Adaption ... 2-129
  Flushing Filter ... 2-121
  Hydraulic System Tester ... 2-128
  Proof Pressure Tester to:
    Flareless Tube or Hose ... 2-126
    Four Bolt Split Flange ... 2-123
    Thirty-Seven Degree Flare ... 2-122
  Multigage ... 2-118
  TEE to:
    Flareless Line ... 2-120
    Four Bolt Split Flange Face ... 2-119
    Four Bolt Split Flange Port ... 2-116
    O-Ring Boss Port ... 2-115
    Pipe Thread Port ... 2-117
    Thirty-seven Degree Flare Line ... 2-96
Analysis, Hydraulic System ... 1-22, 1-24, 2-6

B

Bender, Tube ... 4-1
Body, HSTRU ... 2-15
Brakes, Parking ... 2-9, 2-22
Breaker, Circuit ... 1-30
Bypass Indicator ... 2-9

C

Circuit Breaker ... 4-22
Circuit Breaker Box ... 3-22
Cleaning ... 2-55
Clean Up, HSTRU ... 2-1
Controls and Indicators ... 2-73
Coupling, Clamp Type ... 2-69
Coupling, Hose, Assembly ... 1-23
Crosscut Vise ... 2-64

D

Daily Checks ... 2-23
Damage Inspection ... 1-5
Data Plates ... 1-5

SUBJECT Page

D

Deburring Tool 1-21, 1-23
Drop Light 1-41

E

Electrical Circuit Hook Up Indicator 2-13
Electrical Distribution System 3-13, 4-6
Electrical System Schematic 3-14
Electrical Tools 3-17, 4-10
Emergency Procedures 2-140
Equipment Description 1-4
Equipment Improvement Recommendations 1-1
Equipment Purpose, Capabilities and Features 1-4
Expendable Supplies and Materials List C-1
External Power Application 2-20
External Power Removal 2-56
Extinguisher, Fire 2-19

F

Fabrication Kit, O-Ring 2-107
Filter
  Flushing 1-22, 1-28, 1-29, 2-43, 2-102
  Solvent 2-35
  Transfer Pump 2-49
Fitting
  Bite Type 2-90
  Flare 2-82
  Identification 2-112
Flaring Examples 2-89
Flaring Procedure 2-82
Flaring Tool 1-22, 1-25, 2-8, 2-26, 2-32, 2-86
  Cone, Preservation 2-86
Flushing Filter 1-22, 1-28, 1-29, 2-43, 2-102
FOD 2-26

G

Gage
  Multi-Range Pressure 1-22, 1-26, 2-12, 2-93, 4-24
  Hand Pump 2-3, 4-21
General Information 1-1
Ground Cable Removal 2-58
Grounding 2-18
Ground Plug Removal 2-53
Ground Stakes, Storage 1-36

SUBJECT — Page

H

Hand Pump 1-22, 1-32, 4-19
Hand Tools, Servicing 3-19
Hose Assembly Fabrication 1-18, 2-64
Hose Coupling Assembler 1-20, 1-21, 2-7
  Operational Check 2-37
  Chuck Inserts 2-70
Hose Cutter 2-4
Hose
  Maximum Working Pressure 2-65
  Skiving 2-71
HSTRU Inspection 2-33
Hydraulic Leaks, HSTRU 2-25
Hydraulic System Tester 1-22, 1-27, 2-11, 2-94, 4-24

I

Impact Wrench 2-104
Indicator, Bypass 1-30
Indicator, Electrical Circuit 2-21
Initial Adjustment 2-64
Inspection, Post Operation 2-54
Installation and Operation 2-1

L

Leg
  Landing Gear 2-16, 2-62
  Stabilizer 2-17
Light, Drop 1-41, 2-34
  Check 2-36
Loading Diagram, Tool Box E-1
Location and Description of 1-4
  Major Components 1-12
Lubrication Order 3-1

M

Maintenance 3-1
  Direct Support 4-1
    Body 4-1
    Electrical Distribution System 4-1
    Electrical Tools 4-10
    Hand Pump 4-19
    Pressure Gage 4-21
    Solvent Cleaning Tray 4-9
    Solvent Tank 4-9

SUBJECT Page

M

Maintenance (Cont'd)
Solvent Wash Pump . . . 4-7
Tube Flaring Tool . . . 4-10
Vise, Machinists . . . 4-19
Forms . . . 1-1
General Support . . . 4-22
Circuit Breaker Box . . . 4-22
Hydraulic System Tester . . . 4-18
Pressure Gage
Multi-Range . . . 4-23
Proof Pressure (Hand Pump) . . . 4-24
Operators and Organizational . . . 3-1
Accessory . . . 3-22
Body . . . 3-12
Electrical Distribution System . . . 3-13
Electrical Tools . . . 3-17
Hand Tools . . . 3-19
Solvent Cleaning System . . . 3-15
Test Equipment . . . 3-22
Maintenance Allocation Chart . . . B-1
Multi-Range Pressure Gage . . . 1-26, 2-12, 2-93, 4-24

N

National Pipe Thread . . . 2-112
Nipple, lubrication . . . 2-72

O

Operation in Unusual Weather . . . 2-138
Operation Under Usual Conditions . . . 2-63
O-Ring Boss . . . 2-113
O-Ring Boss Port . . . 2-116
O-Ring Fabrication Kit . . . 1-35, 1-43, 2-107
O-Ring Kit . . . 1-35, 1-43

P

Packing List, Tool Box . . . D-1
Performance Data . . . 1-4, 1-16, 1-17
Pintile, HSTRU . . . 2-61
Pipe Thread Port . . . 2-115
Power Cable . . . 1-35
Preparation for Movement . . . 2-134
Preparation for Use . . . 2-63
Pressure Gage
Hand Pump . . . 2-3, 4-21

Page

P

ge (Cont'd)
Range 1-22, 1-26, 2-12, 2-93, 4-24
Maintenance Checks and Services 2-114
ssure Tester 1-22, 1-32, 2-29, 2-103
ting 2-114
perational Check 2-48
ransfer 1-31

R

..... A-1
..... 3-1, 4-1
..... 2-28

nces
Parts
oir Pump Test

S

..... 1-18, 1-19
..... 2-4
..... 2-66
..... 2-45
..... 3-14
..... 2-64
..... 2-1
..... 2-68
..... 1-20, 1-21
..... 1-21
..... 2-27, 3-15, 4-9
..... 2-34, 2-107
..... 3-1, 4-1
..... 1-36, 2-59

Hose Cutting
Controls
Maximum Capacity
Operational Checks
hematic, Electrical System
lf Test
rvice Upon Receipt
kiving, Hose
kiving Tool
Solvent Wash System
Maintenance
Operation
Special Tools
Stake, Ground
Storage
Hose
Tool Box
Tubing

T

..... 1-39
..... 1-38
..... 1-40

..... 1-42, 2-10, 2-103
..... 1-18
..... 1-35
..... 1-35
..... 1-35
..... 1-35
..... 1-35
..... 1-18
..... 2-96
..... 3-22
..... 1-27, 2-11

Tachometer
Technical Principles of Operation
Electrical Power Connection
Equipment Storage Arrangement
O-Ring Fabrication Kit
O-Ring Kit
Power Requirements
Tools
Tee Test
Test Equipment
Tester, Hydraulic System

SUBJECT — Page

T

Tester, Hydraulic System (Cont'd) 1-27, 2-11
Analysis 2-94
Maintenance of 3-23
Tool Box
Handling Procedures 2-64
Loading Diagram E-1
Packing List D-1
Towing Hookup 2-60
Transfer Pump 1-22, 1-31, 2-5
Filter 2-51
Operational Check 2-44
Preparation for Use 2-101
Spindicator 2-50
Troubleshooting 3-7
Troubleshooting Adapter Kit 2-110
Tube Assembly Fabrication 1-21, 2-75
Bending 2-77
Cutting 2-76
Deburring 2-76
Measuring 2-75
Tube Bender 1-24, 2-6, 2-77
Tube Fitting Kit No. 2 2-131
Tube Flaring Examples 2-89
Tube Flaring Tool 1-25, 2-8, 2-29, 3-19, 4-17
Tube, Recommended Flaring Pressures 2-87

V

Valve, Reservoir 2-30
Vise, Crosscut 1-21, 1-23
Vise, Machinist 4-19

W

Wash Rack 1-22, 1-33
Wrench, Impact 2-47, 2-104

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